# The impact of macroeconomic growth on women's labour market participation: Does panel data confirm the "feminisation U" hypothesis?


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## *1. Introduction*

A number of theoretical and empirical studies investigate the impact of gender-specific disparities in employment on a country's macroeconomic growth performance. Economists today agree that the active participation of women in the labour market positively contributes to growth. Concerning the inverse impact of growth on women's labour market participation, theoretical models and empirical investigations do not yet offer clear answers. On the theoretical side, there are two different approaches. Whereas the "modernisation neoclassical approach" suggests a positive impact of growth on female labour market participation, the "feminisation U" hypothesis suggests a convex impact, meaning that economic growth first lowers women's labour market participation and increases it at later stages of development. Most cross-country studies assume the "feminisation U", yet they do not yield precise empirical results. The shortcoming of these studies is mainly due to endogeneity problems which are not sufficiently taken into account.

The deficient empirical evidence of a convex impact of growth on female labour market participation represents an essential research gap. Answering the question if growth unambiguously promotes female labour market participation or if growth inconclusively impacts the female labour market participation is of great scientific and political interest. The assumption that growth promoting policies automatically encourage female labour market participation bears the risk of renouncing policies that empower women's status on the labour market. Yet, if one cannot trust the equalising effects of growth, female labour market participation will be lower than its potential level. This leads to high economic costs, not only for women but for society as a whole. Several studies point out that gender-specific disparities in terms of labour market participation lower a country's growth performance and therefore reduce aggregate welfare, for example Galor and Weil (1996), Klasen (1999) or Klasen and Lamanna (2003). Empirical evidence of the "feminisation U" hypothesis would suggest that an explicit enhancement of women's economic opportunities is advisable in order to increase a country's long term economic potential.

Today, the availability of a large data set combining cross-country and time-series observations makes it possible to adequately test the "feminisation U" hypothesis. The data includes observations from over 180 countries over four decades and allows for two substantial improvements in comparison to the existing cross country studies. Firstly, the data provides the opportunity to test for the robustness of the empirical findings by using different specifications for female labour market participation. Secondly, the time dimension of the data makes it possible to control for endogeneity caused by an inverse causality between growth and female labour market participation. I use the data in an edited form and perform OLS-, Instrumental Variables-, Fixed Effects- and System-GMM estimations. I control the estimation results for subgroups of heterogeneous countries and account for time specific effects.

## *2. Previous findings*

Economists today agree that women's labour market participation promotes economic growth. Galor and Weil (1996) emphasise that women's labour market participation provides households with an additional income, which makes greater savings possible. An increase in savings raises the capital stock per worker and thereby increases output. Klasen and Lamanna (2003) add that low female labour market participation artificially restricts the "talent pool" of a nation's labour force, which reduces a country's growth potential. Empirical investigations by Klasen (1999) and Klasen and Lamanna (2003) unambiguously prove the positive impact of women's labour market participation on growth. As today, it is recognised that differences in labour market activities between men and women lower a country's growth performance, in a growing number of countries encouraging women's labour market participation has become an important goal (c.f. World Bank, 2001).

The reverse impact of growth on women's labour market participation is still much less clear, on the theoretical as well as on the empirical side. In theory, there are two different approaches: The first approach suggests an increase of female labour market participation across all stages of economic development ("modernisation neoclassical approach" based on Becker, 1957). The second approach suggests a convex impact of growth on female labour market participation ("feminisation U" hypothesis, based on Boserup, 1970).

The "modernisation neoclassical approach" suggests that women's discrimination in terms of labour market participation does not prevail in a competitive environment, but decreases with increasing growth, because discrimination is not consistent with a capital owner's optimal behaviour of maximising income or utility. As market expansion not only requires producer goods but also human capital, girls and women receive education and enter the labour market.

Opposed to the "modernisation neoclassical approach", the "feminisation U" hypothesis suggests that in early stages of development, growth lowers female labour market participation and increases it only at higher stages of economic development, which leads to a U-shaped relationship between growth and female labour market participation. In many low-income countries, which are characterised by a large agricultural sector and high female labour participation, women work on farms or in home workshop production, where they pursue subsistence activities, contribute to the family income or are self-employed. Fertility rates are high at the same time. When countries undergo a beginning economic growth process, urbanisation and industrialisation polarise the working activities of men and women and therefore increase gender differences in labour market activities. The reduction of the rural sector as well as the growing demand for labour mobility make it more difficult for women to combine family and work. Furthermore, industrialisation and technological change lower the demand for low-skill workers. Due to a privileged access to education, men find work in industrialised sectors more easily than women. Their increased income allows them to financially maintain the family on their own. Hence, urbanisation and industrialisation initially reduce female labour market participation, mainly due to structural change and a dominating income effect. Social norms that stigmatise married women working in blue-collar sectors reinforce the decrease in women's labour market participation during a country's industrialisation process (c.f. Goldin, 1994). With further growth, the exclusion of women from labour market activities leads to tight labour markets. Competitive countries are urged to optimise their "talent pool" and hence women receive more education and employment opportunities. This raises women's opportunity costs of staying at home and a substitution effect becomes dominant. Fertility rates decline and female labour market participation rises.

Present empirical studies assume - but do not clearly prove - the validity of the "feminisation U" hypothesis because measurement and estimation problems inhibit clear and universal conclusions. The studies are based on cross country data and hence focus on the variation between countries only. Goldin (1994) examines the impact of GDP per capita on the share of the labour force of 45 to 59-year old women. The data on the female share of the labour force comes from the United Nations WISTAT collection. The limited age group is chosen in order to exclude women whose fertility decisions impact their labour market participation choices. The estimation is based on observations of 82 countries from the year 1980. The regression results suggest that the female share of the labour force decreases with an increase in the percentage of men employed in the white-collar sector, indicating a negative income effect. Furthermore, the results suggest that the female share of the labour force increases for female education levels over seven years of secondary schooling, indicating a positive substitution effect. Yet, Goldin (1994) does not explicitly test the hypothesis of a convex impact of economic growth on the female share of the labour force, as GDP per capita is not modelled as exogenous variable. Hence, it is unclear at what levels of economic development the substitution effect starts to dominate the income effect, which would lead to a turn in female labour market participation.

Cagatay and Özler (1995) propose an all-in-one estimation model with the female share of the labour force as an endogenous variable and GNP per capita as an exogenous variable. Data on the female share of the labour force are drawn from the World Bank data bases. They estimate the impact of GNP per capita on the share 45 to 59-year old women have in the labour force , based on cross-country data including observations of 96 countries, pooled for 1985 and for 1990. In order to control for the U-shaped pattern of the female share of the labour force along the process of economic development, Cagatay and Özler (1995) include *logGNP* and $logGNP^2$ as exogenous variables in the regression model. To confirm the "feminisation U" hypothesis, the estimated coefficient of $logGNP^2$ must be significantly positive as an indicator of the curve's convexity, which implies that there is a minimum in the data curve. Cagatay and Özler (1995) state that their estimation results prove the validity of the "feminisation U" hypothesis because of the significantly positive *logGNP* coefficient and the significantly negative $logGNP^2$ coefficient. Yet, effectively, the fact that the coefficient for $logGNP^2$ is negative rejects the "feminisation U" hypothesis. The negative coefficient suggests a concave process of female labour market participation along economic development containing a maximum instead of a minimum point.

Goldin's (1994) cross country study does not yield precise results to validate the "feminisation U" hypothesis, and Cagatay and Özler (1995)'s cross country study does not confirm a curve's minimum. Estimation results may be imprecise because of the limited time period of the data and measurement problems. Furthermore, Cagatay and Özler's (1995) estimation results might suffer from endogeneity as it is likely that there are feedback effects between GNP per capita and the female share of the labour force. The two-way causality between the endogenous and exogenous variables bears the risk that the OLS regression produces coefficients of *logGNP* and $logGNP^2$ that are biased and inconsistent.

## *3. Data discussion*

I test the hypothesis of a "feminisation U" based on a large data set that combines cross country and time series data, including observations of over 180 countries and over four decades. As the variables vary over two dimensions, estimators are more accurate and more efficient in comparison to cross country studies. Furthermore, the time dimension of the data allows using lags and deviations as instruments for exogenous variables which limits the risk of obtaining biased estimation coefficients due to endogeneity.

In addition, the data allows for taking measurement problems into account by using a number of different specifiations. Measures of female labour market participation are subject to measurement errors because female work is often informal and therefore unrecorded. In developing countries, for example, many women still work informally in the agricultural sector and in the black market (c.f. Chen, Sebstad and O'Connel, 1999). Furthermore, non-paid family work and self-employed work are difficult to register. This holds especially for women's subsistence activities in the agricultural sector. The UNDP (1995) shows that 66% of the female activities in developing countries are not captured by national accounts, compared to only 24% of male activities. Therefore, changes in the quantity and productivity of these activities can only be measured insufficiently (c.f. Waring, 1988; Klasen, 2002). Furthermore, measures of female labour market participation are not always comparable across countries as definitions and measurement concepts vary (c.f. Bardhan and Klasen, 1999; Forbes, 2000). Measurements disaggregated by gender tend to be incomplete and inconsistent in terms of time, which leads to a gender bias in official statistics.

To smooth out these measurement problems, I use three alternative empirical specifications for female labour market participation as an endogenous variable, that is the female share of the labour force (*FLF*), the female activity rate (*FAR*) and the ratio of the female to the male activity rate *(RAR).* All measures include wage workers, unpaid family workers and self-employed workers, but exclude homemakers, unpaid caregivers and workers in informal sectors (c.f. Morrisson and Jütting, 2005).

Data on *FLF* are drawn from the World Bank's World Development Index Data Base (2006) and cover the years 1980 to 2004 for 186 countries. Data on *FAR* and *RAR* are drawn from the ILO Laboursta Data Base (2007) and cover the years 1960 to 2005 for 171 countries (see sample statistics in table 1).

All measures of female labour market participation contain women aged 15 and older. In order to maintain a large data set (with early observations from the 1960s on and from over 180 countries), I do not limit the age group. However, the large age group contains young women whose fertility decisions impact their labour market participation decisions. Furthermore, the age group contains women whose changes in education levels impact their labour market participation decisions. This is why aggregated fertility rates (*FERT*) and aggregated female education levels (*EDU*), which refer to the percentage of women of the population aged 15 and over who have successfully completed secondary schooling, are included as exogenous variables in part of the regressions. Data on fertility are drawn from the World Bank's World Development Index Data Base (2006) and include observations for 197 countries over the years 1960 to 2004. Data on the educational attainment of the female population are drawn from Barro and Lee (2000). The data set provides estimates for 120 countries at five-year intervals for the years 1950-2000 (see sample statistics in table 1).

The indices of female labour market participation cannot be compared to each-other directly. As *FLF* measures the share of women in the *total* labour force, its mean (39%) is naturally lower than that of the *FAR* (42%), which measures the share of working women in the *female* working age population. Observations on *FLF* are distributed evenly across years and across countries, but the observations start in 1980 only. Concerning observations on *FAR* and *RAR,* there are fewer observations for the 1960s and 1970s than from 1980 on and Sub-Saharan Africa countries are underrepresented. Furthermore, *FLF* contains more than three times the number of observations than *FAR* and *RAR*.

Data on GDP per capita (in constant 2000 US$) as an exogenous variable are drawn from the World Bank's World Development Index Data Base (2006) and cover the years 1965 to 2004 for 184 countries. In order to capture proportional rather than absolute differences in the distribution of GDP levels, I use the logarithm of GDP per capita (*logGDP*), which is standard in most macro-econometric works.

Figure 1, which scatters *FLF* against *logGDP,* suggests a U-shaped relationship between the two variables. The relationship between *FAR* and *logGDP* or *RAR* and *logGDP* tells a similar story (figure not show here), with somewhat more observations for low levels of GDP per capita. On the left upper side of figure 1, we find countries that have a high *FLF* (around 50%) and at the same time low GDP per capita levels (sometimes under 200 US$). These observations are mainly from the early 1980s and largely contain Sub-Saharan Africa countries such as for example Burundi, Rwanda, Liberia, Ethiopia, Congo, Mozambique and Malawi. On the right upper side, we find countries that have both a high *FLF* (around 42%) and high GDP per capita levels (over 2000 US$). These observations are mainly from the 1990s and the years 2000-2004 and contain largely OECD countries. The lowest points of the figure, observations with a low *FLF* (under 25%) and medium-level income (between 1000 US$ and 2000 US$), are represented mostly by Latin American and North African countries, such as Venezuela, Mexico, Ecuador, Morocco, Egypt, Tunisia and Algeria. The observations are mainly from the 1980s. So far, these observations are in line with the "feminisation U" hypothesis. Observations which are not in line with the hypothesis are the outliers in the bottom-right corner of figure 1. Countries with high GDP levels and low *FLF* at the same time are oil exporting, Muslim countries of the Middle East, such as the United Arab Emirates, Saudi Arabia, Qatar or Kuwait. These countries owe their high income levels largely to the export of natural resources and obtain a rent which is hardly produced by human capital. Other observations that do not fit into the U-shaped curve are those in the upper middle within the curve. These are, in parts, observations from the former Eastern Bloc countries in the years 1980 to 1995. Within this period, countries like Slovakia, Hungary or Poland recorded high levels of *FLF* relative to their average level of GDP per capita, mainly due to wide-spread affordable child care infrastructure, which was strongly fostered by the communist regimes.

## *4. Econometric specification*

In order to determine whether female labour market participation is a square function of the log of GDP per capita, I estimate two models.

The basic model is:

$$FemaleLabourMarketParticipation_{it} = \beta_1 + \beta_2 \log GDP_{it} + \beta_3 \log GDP^2{}_{it} + \varepsilon_{it} \qquad (1)$$

$\beta_1$ represents the constant term, *logGDP* the log of GDP per capita and *logGDP²* the square of *logGDP*. The coefficient of *logGDP* and of *logGDP²* capture the "feminisation U". To confirm the hypothesis of a "feminisation U", the coefficient $\beta_3$ must be significantly positive as an indicator of the curve's convexity, which implies that there is a minimum point in the data plot. $\varepsilon$ represents the random error term distributed normally with mean zero.

An extended model includes fertility rates (*FERT*) and educational levels (*EDU*) as exogenous variables in order to filter out their impacts on female labour market participation. Furthermore, this model controls for country- and time-specific effects:

$$FemaleLabourMarketParticipation_{it} = \beta_1 + \beta_2 \log GDP_{it} + \beta_3 \log GDP^2{}_{it} + \beta_4 FERT_{it} + \beta_5 EDU_{it} + \beta_6 OECD + \beta_7 LA + \beta_8 EA + \beta_9 SSA + \beta_{10} MENA + \beta_{11} DV1960s + \beta_{12} DV1970s + \beta_{13} DV1980s + \beta_{14} DV1990s + \beta_{15} MUSLIM + \varepsilon_{it} \quad (2)$$

with: *LA:* Latin America; *EA:* East Asia; *SSA:* Sub-Saharan Africa; *MENA:* Middle East and North Africa
*MUSLIM:* Muslim population ≥ 50%

For all estimations methods I do not use the panel data as it is but in an edited version: For every country, I use means of 5 years for the observations of the endogenous variable and observations of the beginning year of the respective mean for the exogenous variables. For example, if a country's observation of *FLF* is the mean of the years 1980-1984, the corresponding observation of *logGDP* is from 1980. This implies that I use lagged exogenous variables in order to capture possible endogeneity. The data preparation procedure provides quinquennial data. I do not use one year lags but create means and lags of five years because the technical structure of the data is unknown. The data contains mainly yearly observations, but in some countries the data inquiry probably takes place only every 5 to 10 years. The data on education, for example, provides only observations at 5-year-intervals. Moreover, the partition of the measured time period in five year-sections limits time series variations, because five year-intervals are less likely to be serially correlated than annual data.

As the panel data contains observations that vary over time, it is possible that the cross sectional time series are marked with a trend. The data would then be non-stationary, meaning that the mean and the variance of a variable change over time. Consequently, the estimated coefficients would be inefficient, because the standard errors and t-values would be estimated too high (spurious regression results). To test for possible non-stationarity, I apply a panel data unit root test that go back to Levin, Lin and Chu (2002). Levin, Lin and Chu (2002) assume that the stochastic process of a time series has a "unit root" when the coefficient of the lag is 1, meaning that the actual value of a variable keeps its past value completely in memory. If the coefficient is smaller than 1, the memory decreases with the size of the lag (geometric series), meaning that the time series is stationary. The test's null hypothesis is that each variable's time series contains a unit root against the alternative that each time series is stationary. The unit root test demands balanced panel data. Therefore I apply the test for a sub-set of the quinquennial data, using only observations of the OECD countries and the years 1980-2000. This seems appropriate since time trends are especially important for homogenous sub-groups of countries. The drawback is that the balanced data have a smaller time dimension (only five periods) than the original data. I run the unit root test for the four variables *FLF*, *FAR*, *RAR* and *logGDP*. The test (results not shown here) reveals that the lagged level of all four series is negative and significantly different from 1, indicating that the presence of a unit root is rejected. Therefore, I can assume that all four variables are stationary, which implies that it is appropriate to apply standard interference to the estimation results. Nevertheless, it cannot be excluded that the test does not find a unitroot because of the small time dimension of the data.

Based on the quinquennial data, I start with a pooled OLS regression. To further control for possible endogeneity, I use an instrumental variables estimator (IV) in a second step. For the basic model (1), I use lagged variables of *logGDP* as instruments for *logGDP* and lagged variables of *logGDP²* as instruments for *logGDP²*. Concerning model (2), I also use lagged variables of *FERT* as instruments for *FERT* and lagged variables of *EDU* as instruments for *EDU*. I create the lagged variables again by using the quinquennial data and I perform the IV-regression in two steps (Two Stage Least Squares Estimator, see appendix 1 for mathematical documentation).

The OLS- and IV-estimation do not account for unmeasured country-specific factors. Consequently, the estimated OLS- and IV-coefficients may be biased and inconsistent due to omitted exogenous variables. Hence, in a third step I use a fixed effects estimation model (FE) that allows the exclusion of variables that vary from country to country but are constant over time. A Hausman test suggests that the fixed effect specification is superior to a random effects specification in controlling for unobserved country-heterogeneity in the magnitude of the time-series relationship between the female labour market participation and economic development. In addition, I use a one step System Generalized Method of Moments (System GMM) estimator, which also allows the exclusion of country-specific time-constant exogenous variables. Furthermore, System GMM considers possible endogeneity by making orthogonal deviations in order to obtain instruments for the exogenous variables (c.f. Arellano and Bover, 1995; Blundell and Bond, 1998). In addition, System GMM differs from the other estimation methods by the presence of a lagged endogenous variable ($FLF_{t-1}$, $FAR_{t-1}$, $RAR_{t-1}$ respectively) among the exogenous variables, which allows controlling for the dynamics of adjustment.

## *5. Estimation Results*

In the following, only regression results of model (2) are shown as the regression results of model (1) are very similar to those of model (2). Furthermore, the fit of model (2) is better than of the basic estimation model (1). Table 2 shows the estimation results with *FLF* as dependent variable. For all estimation methods, the coefficient of *logGDP* is significantly negative and the coefficient of $logGDP^2$ is significantly positive. As the System GMM estimation is the most appropriate estimation method for the used data, I interpret the regression results of the last column in more detail. The positive coefficient of $logGDP^2$ confirms the “feminisation U” hypothesis as it indicates the curve’s minimum. As $logGDP^2$ is a function of *logGDP*, the two coefficients can not be interpreted separately. The coefficient of *logGDP* (-3,111) and of $logGDP^2$ (0,223) indicate that an increase of *logGDP* decreases the female share of the labour force for small levels of *logGDP* ($logGDP<7$) and increases *FLF* from a higher level of *logGDP* on ($logGDP>7$) (see appendix 2 for a mathematical analysis). This leads to a U-shaped pattern between *FLF* and *logGDP*.
To illustrate the association between *FLF* and *logGDP* indicated by the coefficients of *logGDP* and $logGDP^2$ in the last column, I calculate the accompanying *FLF* for every level of *logGDP* ranging between 4,03 and 10,88, which are the minimum and the maximum of *logGDP* according to the data set (see table 1). Figure 2 illustrates a clear U-shaped pattern between *FLF* and *logGDP* based on these coefficients. The minimum of the curve is located at a *logGDP*-value of 7, which is around 1.100 US$ per capita per year. The corresponding *FLF*-value is around 8%. In the figure, *FLF* varies only between 8% and 11%, because $FLF_{t-1}$ is included as exogenous variable in the System GMM estimation model, and therefore around 80% of the female share of the labour force is explained by its own past values. Without $FLF_{t-1}$, *FERT, EDU, DV1980s* and *DV1990s* as exogenous variables, *FLF* would vary between levels of 20% and 50% (estimation results and figure not shown here), which corresponds to the variation supposed by the data scatter in figure 1.

The same regressions are run again with a data set excluding the outliers pointed out by figure 1, which are observations of the oil exporting (OPEC) countries (Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela) and countries of the former Eastern Bloc (Bulgaria, Czech Republic, Slovakia, Hungary, Poland and Romania). For all estimation methods, the values of the coefficients of *logGDP* and $logGDP^2$ rise in value, and hence dropping the outliers further supports the validity of the “feminisation U” hypothesis suggested by the estimation results.

Table 3 shows the estimation results of model (2) with *FAR* and with *RAR* as endogenous variables, for the FE and the System GMM estimation. The OLS and IV estimation results which confirm the “feminisation U” hypothesis are not shown here. The System GMM results in the third and forth columns also confirm the "feminisation U" hypothesis, as the coefficient of *logGDP* is significantly negative and the coefficient of *logGDP²* is significantly negative for both the *FAR*- and the *RAR*-specification. However, concerning the fixed effects estimation (FE), the coefficients of *logGDP²* are not significant for either specification. Furthermore, the coefficient of *logGDP* is not significant for the *FAR*- and little significant for the *RAR*-specification (first and second column of table 3). Hence, the results of the *FAR*-and *RAR*-specifications are less convincing that those of the *FLF*-specification.

One may think of differences in the data structure as reasons for this finding. For example, *FAR*- and *RAR*-measures contain observations from the 1960s and 1970s whereas *FLF*-measures only contain observations from 1980 on. Hence, model (2) is re-estimated with *FAR* and with *RAR* as endogenous variables based on data without observations from the 1960s and 1970s. Yet, concerning the fixed effects estimation (FE), the coefficients of *logGDP* and of *logGDP²* do not get more significant, neither for the *FAR*- nor for the *RAR*-specification (estimation results not shown here). However, concerning the OLS, IV and System GMM estimation, the coefficients of *logGDP* stay significantly negative and the coefficients of *logGDP²* stay significantly positive also without observations from the 1960s and 1970s.

Furthermore, it is possible that for the *FAR*- and *RAR*- specifications, the insignificant coefficients of *logGDP* and *logGDP²* result from the FE-estimation technique itself, as the fixed effects model captures only within-country variation. To focus on within-country variation more precisely, I estimate the FE-model based on a smaller data set containing only subgroups of homogenous countries, namely OECD countries and Sub Saharan African (SSA) countries. Table 4 shows the regression results for the *FLF*-, *FAR*- and *RAR*-specifications, based on model (2). For OECD countries, the coefficient of *logGDP* is significantly negative and the coefficient of *logGDP²* is significantly positive, not only for the *FLF*-specification, but now also for the *FAR*- and *RAR*-specifications. This suggests that for OECD countries, the "feminisation U" hypothesis can be confirmed also for within-country variation. For SAA countries however, the coefficients of *logGDP* and of *logGDP²* change their sign and are not significant regardless of the specification. A closer look at the data shows that for several SSA countries, for example Gambia, Kenya, Senegal or Zimbabwe, the relationship between female labour market participation and *logGDP* is strictly negative, independent of the specification. Yet, this does not allow for a general rejection of the "feminisation U" hypothesis for SSA countries, because the observed time period is probably too small to observe a whole U-shaped curve. As in many developing countries the greater urbanisation and industrialisation processes just started (c.f. Cohen, 2006) it is likely that the turning point with an increase in female labour market participation is in the near future. At the same time, even though for the group of OECD-countries the "feminisation U" hypothesis is confirmed for within-country variation, in some industrialised countries, like in the USA, in France or in Germany for example, there is a strictly positive relationship between female labour market participation and *logGDP*. Here again, the observed time period may be too small to observe a whole U-shaped curve, as the data contains neither observations of *FLF* before 1980 nor observations of *FAR* or *RAR* before 1960. Goldin (1994) shows for the USA, and Marchand and Thélot (1997) for France, that in these countries the period of decreasing female labour market participation took place before 1980, respectively 1960, but in the first period of the twentieth century.

Hence, the significant results of the pooled OLS, IV- and System GMM regressions confirm the "feminisation U" hypothesis, but the FE results suggest that the U-shaped curve is mainly founded on between-country variation. Furthermore, the regression results indicate that time effects play an important role when focusing on within-country variation. Table 3 and table 4 show that the time-specific dummy variables are significant for the FE-regression. In contrast, table 3 shows that the time specific dummy variables are not significant for the System GMM regression which captures both within- and between-country variation. In order to intensify the control for time effects, a two way fixed effects model is used. This means that time dummies for each period of the quinquennial data (*DV1960, DV1965, ... DV2005*) are included instead of time dummies for each decade. Now, the estimated coefficients for *logGDP* and *logGDP²* are even less significant, which may be due to a dummy variable trap (estimation results not shown here). Yet, the fact that the time dummies are again all highly significant indicates that time effects, as for example time based shocks, need more consideration.

In order to smooth out time based shocks, such as periodical fluctuations of GDP, for example, a moving average (MA) procedure is applied. This procedure smoothes out short-term fluctuations and highlights longer-term trends or cycles. A simple MA-procedure creates a new series for each variable, in which each observation is a mean of the nearby observations in the original series. Using the quinquennial data, uniformly weighted moving average-variables are created of all relevant variables *(FLF, FAR, RAR, logGDP, logGDP², FERT* and *EDU*) by using two lagged terms and three forward terms of each observation, and by including the current observation in the filter. Then the FE-model using the created moving MA-variables is estimated. Table 5 shows the regression results. Now the estimated coefficient of *logGDP* is significantly negative and the estimated coefficient of *logGDP²* is significantly positive also for the *FAR*- and *RAR*-specifications. The coefficients stay significant also when applying the two way fixed effects model.

## *6. Conclusion*

The empirical analyses confirm a convex impact of GDP on female labour market participation. Due to the limited time period of the data, the “feminisation U” is dominated by between-country variation. For within-country variation, a significant convex relation set can only be observed when smoothing out short-term fluctuations in the data.

Contrary to previous cross-country studies, this study takes endogeneity problems into account accurately as it uses a large cross sectional time series data set. Furthermore, the robustness of the findings is proved by using three specifications of female labour market participation.

The evidence that growth lowers women’s labour market participation at early stages of development suggests that in developing countries, economic growth encourages women’s labour market participation only in combination with policy intervention. Accompanying growth-promoting policies with decent and productive work opportunities for women is a major challenge to prevent women from dropping out of the labour market or from getting stuck in low paid jobs in the informal economy. This is all the more true since encouraging female employment is growth promoting not only for developing, but also for industrialised countries.

The drawback of the large data base including observations from developing countries and from early time periods on is that the regression results can be subject to measurement errors. Measurement problems concerning the female labour market participation, especially caused by women’s widespread informal economic activities in developing countries, may bias the estimation results, even though three specifications are used. Furthermore, in order to keep the data set large, measures of economic development as an exogenous variable are limited to GDP, and measures of female labour market participation are not differentiated by employment status, by hours worked or by sector. For the same reason, the estimation models do not control for the impact of other possible macro-level determinants of female labour market participation that vary over time, such as for example family policy instruments. Extending the estimation model by more and by more specific variables is a field of further research, even though data availability makes it necessary to concentrate on a subgroup of countries and years.

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**Appendix 1:** *IV-regression in two steps (Two Stage Least Squares) for model (1)*

*Step 1:*

Estimation of a reduced form which regresses the endogenous regressor $\log G\hat{D}P_{i,t}$ over the instrument $\log GDP_{i,t-1}$:

$$\log G\hat{D}P_{i,t} = \beta_1 + \beta_2 \log GDP_{i,t-1} + \varepsilon_{i,t}$$

Calculation of $\log G\hat{D}P_{i,t}$ based on the estimated coefficients in step one.

Calculation of $\log G\hat{D}P^2{}_{i,t}$ using $\log G\hat{D}P_{i,t}$.

*Step 2:*

Estimation of the female labour market participation *(FLF, FAR, RAR)* based on $\log G\hat{D}P^2{}_{i,t}$ and on $\log G\hat{D}P_{i,t}$:

$$FemaleLabourMarketParticipation_{i,t} = \beta_1 + \beta_2 \log G\hat{D}P_{i,t} + \beta_3 \log G\hat{D}P^2{}_{i,t} + \varepsilon_{i,t}$$

**Appendix 2:** *Quantification of the regression results based on the coefficients of logGDP and logGDP² of the System GMM estimation (table 2, column 4).*

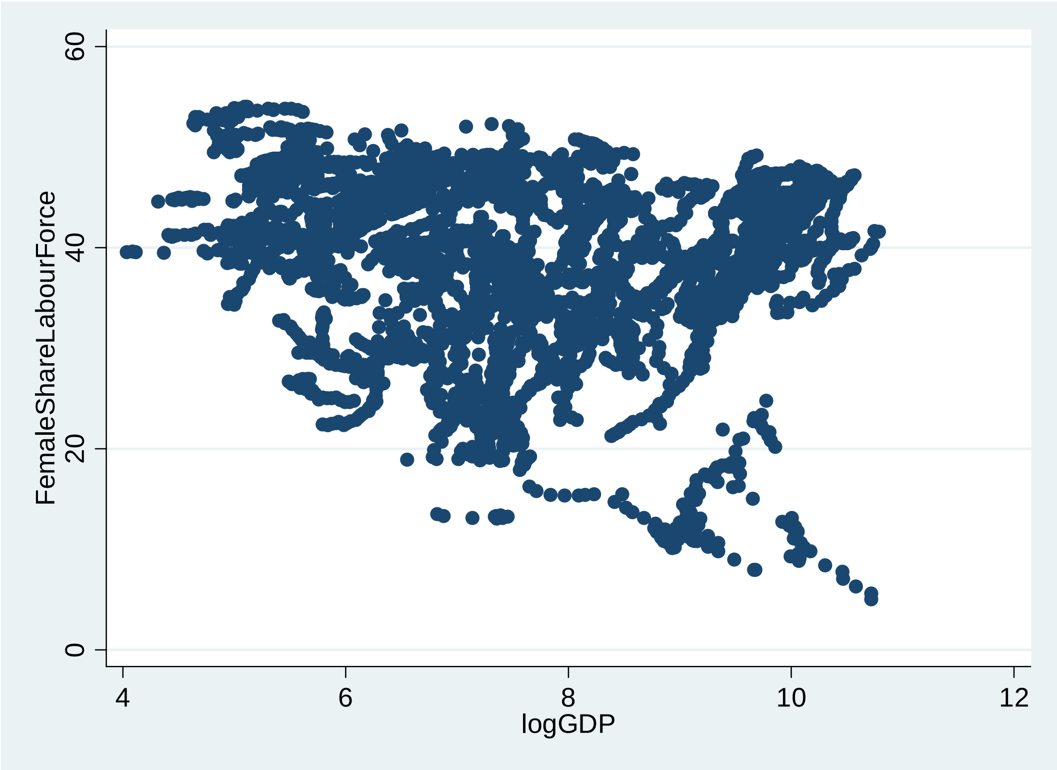
The first derivation of the estimation function shows that the impact of an increase of *logGDP* on *FLF* depends on the level of *logGDP*:

$$FLF = 18{,}87 - 3{,}111 \log GDP + 0{,}223 \log GDP^2$$

$$\frac{\delta FLF}{\delta \log GDP} = -3{,}111 + 0{,}446 \log GDP$$

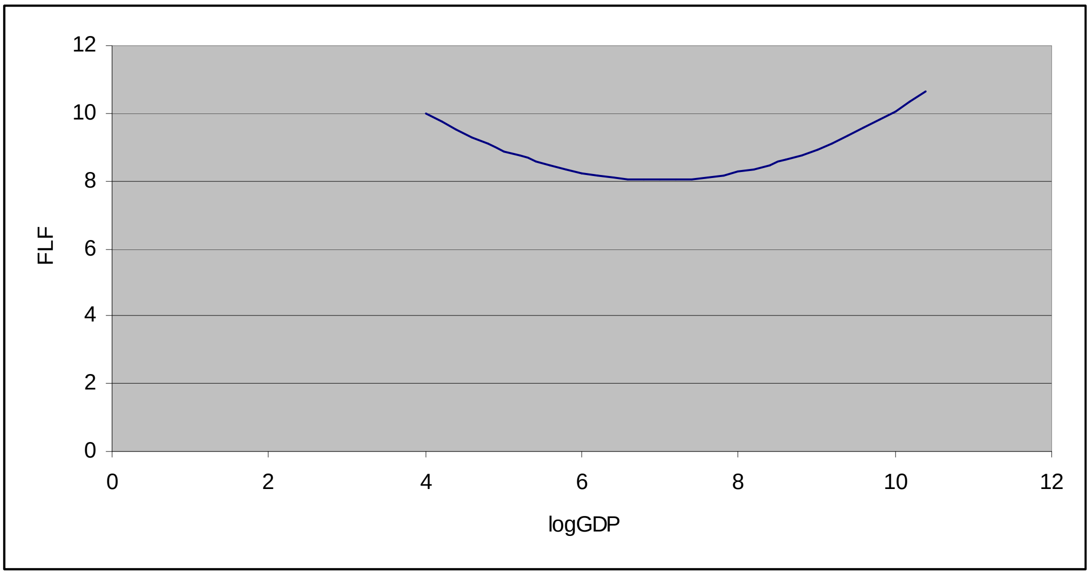
$$\frac{\delta FLF}{\delta \log GDP} = 0 \Leftrightarrow \log GDP = 7$$

***Figure 1:*** *Female share of the labour force (FLF) against logGDP*




observations from 184 countries, 1980 to 2004

***Figure 2:*** *Female share of the labour force* (*FLF) against logGDP*




graph based on System GMM-regression results,
estimation model (2) with $FLF_{t-1}$ among the exogenous variables

***Table 1:*** Descriptive statistics

| variable | nb.of observ. | nb.of countries | time period | mean | std. dev. | min | max |
|---|---|---|---|---|---|---|---|
| *FLF* | 4535 | 186 | 1980-2004 | 38.70 | 8.92 | 5.05 | 54.04 |
| *FAR* | 1372 | 171 | 1960-2005 | 42.19 | 15.68 | 2.5 | 93.1 |
| *RAR* | 1372 | 171 | 1960-2006 | 0.56 | 0.18 | 0.29 | 1.08 |
| *logGDP* | 5817 | 184 | 1965-2004 | 7.48 | 1.54 | 4.03 | 10.88 |
| *EDU* | 800 | 120 | 1950-2000 | 7.54 | 8.15 | 0.1 | 50.8 |
| *FERT* | 4485 | 197 | 1960-2004 | 3.63 | 1.98 | 0.84 | 8.5 |

*FLF:* Female share of the labour force (women aged 15 and older)
*FAR:* Female activity rate (women aged 15 and older)
*RAR:* Ratio female / male activity rate (men and women aged 15 and older)
*logGDP:* log of GDP per capita (in constant 2000 US$)
*EDU:* Percentage of women of the population aged 15 and over who have successfully completed secondary schooling
*FERT:* Total fertility rate

***Table 2***: *The impact of logGDP on FLF: model (2)*

| | (1) Pooled OLS | (2) IV | (3) FE | (4) System GMM |
|---|---|---|---|---|
| | *FLF* | *FLF* | *FLF* | *FLF* |
| *Constant* | 81.85*** | 84.48*** | 64.90*** | 18.87*** |
| | (8.85) | (8.77) | (7.87) | (6.30) |
| *logGDP* | -9.649*** | -10.42*** | -8.843*** | -3.111*** |
| | (-4.25) | (-4.37) | (-3.85) | (-5.01) |
| *logGDP²* | 0.566*** | 0.621*** | 0.742*** | 0.223*** |
| | (3.87) | (4.02) | (4.47) | (5.96) |
| *L.FLF* | . | . | . | 0.804*** |
| | . | . | . | (71.91) |
| *FERT* | -0.738* | -0.930* | -0.643* | -0.0941 |
| | (-2.28) | (-2.55) | (-2.49) | (-1.21) |
| *EDU* | 0.0376 | 0.0573 | -0.0392 | 0.00223 |
| | (0.82) | (1.22) | (-1.29) | (0.24) |
| *OECD* | 1.569 | 0.926 | . | . |
| | (1.57) | (0.86) | . | . |
| *LA* | -4.056*** | -3.013** | . | . |
| | (-4.59) | (-3.15) | . | . |
| *EA* | -0.344 | -1.144 | . | . |
| | (-0.17) | (-0.58) | . | . |
| *SSA* | 4.933*** | 5.235*** | . | . |
| | (5.03) | (4.90) | . | . |
| *MENA* | -5.432*** | -4.936** | . | . |
| | (-3.40) | (-2.81) | . | . |
| *DV1980s* | -1.798* | -1.530 | -1.280** | 0.0845 |
| | (-2.34) | (-1.85) | (-2.83) | (0.81) |
| *DV1990s* | -0.292 | 0.0488 | -0.438 | -0.0297 |
| | (-0.42) | (0.07) | (-1.46) | (-0.37) |
| *Muslim* | -9.036*** | -8.318*** | . | . |
| | (-9.41) | (-7.99) | . | . |
| F | 38.64 | 29.90 | 24.39 | . |
| Wald Chi² | . | . | . | 16442.82 |
| N | 450 | 379 | 450 | 366 |
| $R^2$ | 0.5148 | 0.4950 | . | . |
| $R^2$ adjusted | 0.5015 | 0.4785 | . | . |
| $R^2$ within | . | . | 0.3040 | . |

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

*FLF:* Female share of the labour force (women aged 15 and older)
*logGDP:* log of GDP per capita (in constant 2000 US$)
*EDU:* Percentage of women of the population aged 15 and over who have successfully completed secondary schooling
*FERT:* Total fertility rate
*OECD:* dummy variable for OECD countries
*LA:* dummy variable for Latin America
*EA:* dummy variable for East Asia
*SSA:* dummy variable for Sub-Saharan Africa
*MENA:* dummy variable for Middle East and North Africa
*MUSLM:* dummy variable for countries with Muslim population ≥ 50%
*DV1960s, DV1970s, DV1980s, DV1990s*: time-specific dummy variables for decades

***Table 3:*** The impact of *logGDP* on *FAR* and *RAR*: model (2)

| | FE | | System GMM | |
|---|---|---|---|---|
| | *FAR* | *RAR* | *FAR* | *RAR* |
| *Constant* | 146.7** | 2.033*** | 181.6*** | 1.722*** |
| | (2.88) | (3.40) | (10.62) | (7.60) |
| *logGDP* | -18.37 | -0.290* | -37.16*** | -0.342*** |
| | (-1.53) | (-2.05) | (-9.50) | (-6.56) |
| *logGDP²* | 0.855 | 0.0156 | 2.187*** | 0.0203*** |
| | (1.16) | (1.80) | (9.24) | (6.44) |
| *L.FAR resp. L.RAR* | . | . | 0.586*** | 0.668*** |
| | . | . | (19.05) | (20.66) |
| *FERT* | -2.164* | -0.0242 | -2.541*** | -0.0331*** |
| | (-2.00) | (-1.90) | (-5.91) | (-5.86) |
| *EDU* | 0.0566 | 0.000202 | -0.0373 | -0.000483 |
| | (0.42) | (0.13) | (-0.55) | (-0.55) |
| *DV1960s* | -15.50** | -0.254*** | 0.795 | -0.0140 |
| | (-2.94) | (-4.11) | (0.36) | (-0.49) |
| *DV1970s* | -15.24*** | -0.236*** | -0.796 | -0.00886 |
| | (-5.09) | (-6.70) | (-0.59) | (-0.49) |
| *D1980s* | -8.092*** | -0.128*** | 0.940 | 0.0141 |
| | (-3.96) | (-5.33) | (0.94) | (1.07) |
| *DV1990s* | -3.350* | -0.0555** | 0.160 | -0.00155 |
| | (-2.31) | (-3.26) | (0.18) | (-0.14) |
| F | 21.45 | 35.48 | . | . |
| Wald Chi² | . | . | 813.83 | 1052.55 |
| N | 329 | 329 | 221 | 221 |
| R² within | 0.4273 | 0.5524 | . | . |

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

*FAR:* Female activity rate (women aged 15 and older)
*RAR:* Ratio female / male activity rate (men and women aged 15 and older)
*logGDP:* log of GDP per capita (in constant 2000 US$)
*EDU:* Percentage of women of the population aged 15 and over who have successfully completed secondary schooling
*FERT:* Total fertility rate
*DV1960s, DV1970s, DV1980s, DV1990s*: time-specific dummy variables for decades

***Table 4:*** The impact of *logGDP* on *FLF, FAR* and *RAR* for subgroups of countries

| | Fixed Effects estimation | | | | | |
|---|---|---|---|---|---|---|
| | OECD | | | SSA | | |
| | *FLF* | *FAR* | *RAR* | *FLF* | *FAR* | *RAR* |
| *Constant* | 321.4*** | 808.3*** | 7.711** | 34.73*** | -190.8 | -1.367 |
| | (3.81) | (3.64) | (2.78) | (5.84) | (-0.35) | (-0.19) |
| *logGDP* | -64.59*** | -159.0*** | -1.535** | 1.145 | 95.62 | 0.937 |
| | (-3.76) | (-3.50) | (-2.71) | (0.56) | (0.62) | (0.47) |
| *logGDP²* | 3.722*** | 8.316*** | 0.0838** | -0.104 | -8.248 | -0.0840 |
| | (4.20) | (3.51) | (2.84) | (-0.58) | (-0.76) | (-0.60) |
| *FERT* | -1.768** | -1.474 | -0.0137 | 0.923*** | -4.532 | -0.0766 |
| | (-2.81) | (-0.84) | (-0.62) | (4.96) | (-0.74) | (-0.96) |
| *EDU* | -0.0592* | 0.0719 | 0.000198 | -0.0368 | 1.838 | 0.0207 |
| | (-2.39) | (0.63) | (0.14) | (-0.80) | (1.58) | (1.38) |
| *DV1960s* | ; | -13.73* | -0.207** | . | . | . |
| | . | (-2.45) | (-2.95) | . | . | . |
| *DV1970s* | . | -14.21*** | -0.211*** | . | -9.265 | -0.184 |
| | . | (-3.83) | (-4.55) | . | (-0.65) | (-0.99) |
| *DV1980s* | -0.924 | -6.378* | -0.0973** | -0.125 | -2.565 | -0.0829 |
| | (-1.22) | (-2.58) | (-3.15) | (-0.43) | (-0.21) | (-0.52) |
| *DV1990s* | 0.00668 | -1.823 | -0.0267 | 0.0119 | -7.456 | -0.130 |
| | (0.01) | (-1.01) | (-1.18) | (0.06) | (-1.02) | (-1.37) |
| F | 28.45 | 16.64 | 28.17 | 10.95 | 0.91 | 1.56 |
| N | 116 | 118 | 118 | 122 | 45 | 45 |
| $R^2$ within | 0.6728 | 0.6131 | 0.7285 | 0.4275 | 0.2971 | 0.4209 |

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

*FLF:* Female share of the labour force (women aged 15 and older)
*FAR:* Female activity rate (women aged 15 and older)
*RAR:* Ratio female / male activity rate (men and women aged 15 and older)
*logGDP:* log of GDP per capita (in constant 2000 US$)
*EDU:* Percentage of women of the population aged 15 and over who have successfully completed secondary schooling
*FERT:* Total fertility rate

***Table 5:*** The impact of *logGDP* on *FLF, FAR, RAR* (Moving Average Variables)

| | FE estimation | | |
|---|---|---|---|
| | *FLF_MA* | *FAR_MA* | *RAR_MA* |
| Constant | 65.04*** | 161.9*** | 2.186*** |
| | (10.60) | (4.09) | (4.54) |
| *logGDP_MA* | -7.688*** | -26.10** | -0.380*** |
| | (-4.89) | (-2.80) | (-3.35) |
| *logGDP²_MA* | 0.591*** | 1.420* | 0.0224** |
| | (5.59) | (2.48) | (3.21) |
| *FERT_MA* | -0.697*** | -1.537 | -0.0149 |
| | (-3.99) | (-1.63) | (-1.30) |
| *EDU_MA* | -0.0190 | 0.470*** | 0.00419** |
| | (-0.69) | (3.63) | (2.66) |
| *DV1960s* | . | -8.824** | -0.158*** |
| | . | (-3.26) | (-4.80) |
| *DV1970s* | . | -7.862*** | -0.138*** |
| | . | (-4.64) | (-6.68) |
| *DV1980s* | -0.368** | -4.545*** | -0.0755*** |
| | (-2.66) | (-4.63) | (-6.33) |
| *DV1990s* | -0.333*** | -0.977 | -0.0195* |
| | (-3.39) | (-1.32) | (-2.18) |
| F | 28.15 | 35.03 | 56.18 |
| N | 450 | 329 | 329 |
| $R^2$ within | 0.3352 | 0.5493 | 0.6615 |

t statistics in parentheses

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

*FLF_MA:* Female share of the labour force (women aged 15 and older) – moving average
*FAR_MA:* Female activity rate (women aged 15 and older) – moving average
*RAR_MA:* Ratio female / male activity rate (men and women aged 15 and older) – moving average
*logGDP_MA:* log of GDP per capita (in constant 2000 US$) – moving average
*EDU_MA:* Percentage of women of the population aged 15 and over who have successfully completed secondary schooling – moving average
*FERT_MA:* Total fertility rate – moving average
*DV1960s, DV1970s, DV1980s, DV1990s*: time-specific dummy variables for decades