Female Labor Force Participation and Economic Growth: Accounting for the Gender Bonus

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Abstract

This paper shows that a neoclassical aggregate production function yields an accounting effect of female labor force participation (FLFP) on economic growth. This accounting effect, or *gender bonus*, occurs due to a larger number of potential workers in the economy. The theory produces a linear dynamic model whose coefficients we estimate applying a system GMM approach to data from the International Labor Organization and the Penn World Tables. The results imply a positive and statistically significant effect of the growth of FLFP on economic growth and a positive but not statistically different from zero effect of the initial FLFP on economic growth. Importantly, we cannot reject that neither of these effects is only an accounting effect. Therefore, there is no support for secondary bonuses through education or population growth.

Keywords: Female Labor Force; Gender Bonus; Economic Growth
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1 Introduction

During the 20th century, most economies experienced a substantial increase in the participation of women in the labor force, i.e., Female Labor Force Participation (FLFP). For instance, in North America, FLFP went from roughly 60% to 70% between 1980 and 2005.[1] A natural question is whether FLFP increases have had positive and significant effects on a nation's development level. Although several quantitative exercises suggest a positive effect of FLFP on economic growth (Cavalcanti and Tavares, 2016; Cuberes and Teignier, 2016), cross-country econometric evidence is scarce and somewhat conflicting.[2]

In this paper, we show that a traditional neoclassical aggregate production function yields an accounting effect of FLFP on economic growth. This accounting effect, or *gender bonus*, occurs due to a larger number of potential workers in the economy. The theory produces a linear dynamic model whose coefficients we estimate applying a system GMM approach to panel data from the International Labor Organization (ILO) and the Penn World Tables (PWT). The results imply a positive and statistically significant effect of the growth of FLFP on economic growth and a positive but not statistically different from zero effect of the initial FLFP on economic growth. Importantly, we cannot reject that neither of these effects is only an accounting effect.

Our paper contributes to the literature by deriving a growth regression model based on a translation of the neoclassical production function in the spirit of Bloom and Williamson (1998).[3] This is especially helpful in identifying the mechanism by which FLFP affects economic growth, which is a challenge for cross-country regressions (Bandiera and Natraj, 2013). The literature proposes that FLFP may affect economic growth through, for example, declining fertility, increasing human capital, and improvements in the allocation of talent. However, these mechanisms constitute a secondary bonus beyond the accounting effect resulting from the translation of the neoclassical production function. Therefore, the test for these mechanisms must take into consideration the gender bonus. In our empirical exercise, although we find support for a positive effect of FLFP on economic growth, we cannot say that this effect is beyond the gender bonus,

[1] In this paper, we define FLFP as the number of women in the labor force over the number of women age 15 to 65. See Klasen (2020) for a recent analysis of trends.

[2] See Klasen (2018) for a recent review of the literature.

[3] Bloom and Williamson (1998) study the effect of a demographic bonus on economic growth translating the neoclassical production function from per-worker terms into per-capita terms. We extend this translation to account for gender.

i.e., there no empirical evidence for the secondary bonus at the country level.[4]

2 The Model

We begin with the neoclassical per-worker production function; namely, output per worker, z, is

$$z = Ak^{\alpha}h^{(1-\alpha)},$$

where k is the stock of capital per worker, h is the average human capital of the workforce, and A is total factor productivity (TFP). Next, as in Bloom and Williamson (1998), we translate the per-worker production function into a per capita equivalent by noting that $z = yN/L$, where y is production per capita, N is population, and L is the labor force. Substituting this relation into the per-worker production function implies that

$$y = Ak^{\alpha}h^{(1-\alpha)}p\frac{W}{N},$$

where W is the working-age population and $p = L/W$ is the participation rate.

Human capital is described by a Mincerian type equation so that $h = e^{\phi s}$, where s is the average years of schooling of the labor force.[5] Substituting human capital in the per capita production function, taking logs and then differentiating with respect to time, leads to the following growth accounting equation:

$$g_y = g_A + \alpha g_k + (1-\alpha)\phi\Delta s + g_p + g_W - g_N, \tag{1}$$

where g_i denotes the growth rate of variable i and Δ denotes the accumulation. The growth rate of TFP is next assumed to depend on initial labor productivity and initial average years of

[4]The taxonomy used in this paper is analogous to the literature on the demographic bonus associated with increases in the working-age population due to the demographic transition. Lee and Mason (2006) call a secondary demographic bonus the changes in the accumulation of factors of production resulting from changes in the age structure.

[5]This approach is common in the growth literature. See for example, Hall and Jones (1999), Caselli (2005), and Hsieh and Klenow (2010).

schooling of the labor force.[6] Then, a further translation is possible, such that

$$g_A = \lambda \ln z_0 + \eta\phi s_0 + \epsilon = \lambda \ln y_0 + \eta\phi s_0 + \lambda \ln N_0 - \lambda \ln p_0 - \lambda \ln W_0 + \epsilon, \tag{2}$$

where the subscript 0 indicates initial values. The term ϵ is a country- and time-specific unknown that causes TFP to grow. Together, Eqs. (1) and (2) provide a test for the demographic bonus in, for example, Cuaresma et al. (2014) and Baerlocher et al. (2019).

To account for the gender bonus, we depart from the demography literature by splitting the growth rate of the participation rate, g_p, into its male and female components. For this, note that

$$p = \frac{L}{W} = \frac{L_m}{W_m}\frac{W_m}{W} + \frac{L_f}{W_f}\frac{W_f}{W} \approx \frac{p_m + p_f}{2},$$

where L_m and L_f are the male and female labor forces, W_m and W_f are the male and female working populations, and $p_m = L_m/W_m$, $p_f = L_f/W_f$ are the male and female participation rates. Note that in the above equation we have exploited the fact that $W_f/W \approx W_m/W \approx 0.5$. Taking logs of both sides of the above equation and then differentiating with respect to time allows us to divide the growth rate of the participation rate into its female and male participation growth rate components, namely,

$$g_p \approx \frac{p_m}{p_m + p_f} g_m + \frac{p_f}{p_m + p_f} g_f \approx (1 - \theta) g_m + \theta g_f, \tag{3}$$

where θ is the share of women in the labor force, and where g_m and g_f are the growth rates of the male and female participation rates. We also apply the following transformation on the initial participation rate,

$$\ln p_0 = \ln(p_{m0} + p_{f0}) - \ln 2 = \ln p_{m0} + \ln\left(1 + \frac{p_{f0}}{p_{m0}}\right) - \ln 2. \tag{4}$$

Substituting Eqs. (2) to (4) into Eq. (1) and adding $\ln y$ on both sides yields the growth regression equation

[6] This formulation is motivated by theories where countries with lower labor productivity copy the *leader*'s technology, which prompts a catch-up effect (Barro and Sala-i Martin, 1997). Nelson and Phelps (1966) and Benhabib and Spiegel (1994) propose that more educated labor force is prone to adopt technology faster.

$$\ln y_{(it)} = \gamma + \beta^{y} \ln y_{0(it)} + \beta^{s} s_{0(it)} + \beta^{N} \ln N_{0(it)} + \beta^{W} \ln W_{0(it)} + \beta^{p_m} \ln p_{m0(it)} + \beta^{gap} \ln(1 + p_{f0}/p_{m0})_{(it)} + \beta^{g_k} g_{k(it)} + \beta^{\Delta s} \Delta s_{(it)} + \beta^{g_m}(1-\theta) g_{m(it)} + \beta^{g_f} \theta g_{f(it)} + \beta^{g_w} g_{w(it)} + \beta^{g_n} g_{n(it)} + \nu_{(i)} + \psi_{(t)} + \varepsilon_{(it)}, \quad (5)$$

where $\beta^{y} = \lambda + 1$, $\beta^{s} = \eta\phi$, $\beta^{k} = \alpha$ and $\beta^{\Delta s} = (1-\alpha)\phi$. The remaining coefficients result from the translation such that they reflect only accounting effects. Namely, $\beta^{g_f} = \beta^{g_m} = \beta^{g_w} = -\beta^{g_n} = 1$ and $\beta^{p_m} = \beta^{gap} = \beta^{W} = -\beta^{N} = 1 - \beta^{y}$. Note that we allow the error term to contain country and time fixed effects denoted by $\nu_{(i)}$ and $\psi_{(t)}$, respectively.

To test whether there are secondary effects of FLFP on economic growth through the usual mechanisms proposed by the literature, we test whether β^{g_f} and β^{gap} are equal to their accounting effects. We also provide tests of whether all gender variables are equal to their accounting values jointly.

3 Empirical Analysis

Our panel covers over 100 countries from 1980 to 2005 period with data points at 5-year intervals. All demographic variables (i.e., population, working-age population by gender and labor force by gender) are taken from the fifth edition of the International Labor Organization Estimates and Projections of Economically Active Population.[7] The data for real GDP, the real capital stock, and average years of schooling are taken from the Penn World Tables 9.1 (PWT).[8]

Table 1 presents the results using five alternative approaches. In Columns 1 and 2, we assume $\nu_{(i)} = \nu$ for all countries, i. e., no country fixed effects. Column 1 pertains to a long-difference approach where $t = \{1980, 2005\}$. Columns 2 pertains to a Pooled OLS. The remaining columns account for country fixed effect. The naïve fixed effect model is presented in Column 3. It is naïve because it is biased by the interplay between the lagged dependent variable and the fixed effect

[7] The fourth edition together with PWT covers less than a half of the countries, whereas the latest editions comprise a period where the increase of FLFP slowed down (Klasen, 2020). Using more than one edition is not possible due to changes in methodology. See Gaddis and Klasen (2014) for a careful analysis of ILO's data.

[8] To obtain a real stock of capital value, we multiply the capital stock at current prices by the ratio of real GDP to nominal GDP from the PWT. The average years of schooling is a combination of data from Barro and Lee (2013) and the refinements proposed by Cohen and Soto (2007); Cohen and Leker (2014).

dummy (Nickell, 1981). Columns 4 pertains to the fixed effect model with a bootstrap-based bias correction proposed by Everaert and Pozzi (2007). Columns 5 to 7 correct the bias using the one-step system GMM approach with only the first lags as instruments.[9] The GMM columns differ by the variables included in the regression. The system GMM is our most preferred estimation method as it controls for time-invariant characteristics that are unobserved and reduces concerns related to reverse causality.

Table 1 reveals that both initial per-capita output and the growth of per-worker physical capital are associated with economic growth. Whereas the latter has a positive effect on growth, the former has a negative effect, which implies convergence among countries. All models imply a positive relationship between the growth of FLFP and economic growth. The bias-corrected FE is the only approach in which we cannot reject that the coefficient is zero. Importantly, we cannot reject that any coefficient associated with the growth of FLFP is different from its accounting effect. Therefore, gains in development from women moving to market production may be largely due to the increase in the number of workers. The coefficient associated with the growth of MLFP poses a puzzle as it is negative, except in the long-differences and the bias-corrected FE. However, we cannot reject that the coefficients are zero, and for the case of the bias-corrected FE and system GMM, we cannot reject that it equals the accounting effect. A similar puzzle appears for the coefficient associated with the initial MLFP.

All fixed effect models estimate positive coefficients associated with the initial gap variable – $\ln(1 + p_{f0}/p_{m0})$. Nonetheless, the naïve FE overestimates the coefficient suggesting a statistically significant effect. Both the bias-corrected FE and the system GMM find smaller and not statistically significant coefficients. Importantly, our findings suggest that the positive effect of initial FLFP on economic growth found by Klasen and Lamanna (2009) may be due to the bias inherited by the estimation of dynamic panel models with fixed effects. In sum, the models that correct the Nickel's bias, namely Columns 4 and 7 of Table 1, show that we cannot reject the gender-related variables have only accounting effects on economic growth. If this is true, increases in FLFP

[9]One must be careful applying the system GMM as it may produce large standard errors due to weak instruments. As suggested by Bazzi and Clemens (2013), we present the Kleibergen-Paap F statistic, which measures the strength of our instruments (Kleibergen and Paap, 2006). We choose to use only the first lags and collapse the instruments because this arrangement yields strong instruments. We also present the p-value for the Hansen-J test but omit the autoregressive tests. For all GMMs, we reject the null of no serial correlation of order 1, but cannot reject that there is no serial correlation of order 2.

Table 1: The determinants of economic growth

Dependent Variable: $\ln y$	Long Diff.	P. OLS	FE	BCFE	System GMM		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln y_0$	0.75***	0.88***	0.50***	0.72***	1.00***	0.87***	0.85***
	(0.07)	(0.02)	(0.06)	(0.07)	(0.02)	(0.05)	(0.07)
g_k	0.34***	0.37***	0.35***	0.38***	0.50***	0.41***	0.40***
	(0.07)	(0.07)	(0.05)	(0.06)	(0.08)	(0.09)	(0.09)
θg_f	1.70**	1.42***	1.25**	0.99	1.80**	2.00**	1.76**
	(0.79)	(0.53)	(0.54)	(0.71)	(0.82)	(0.93)	(0.89)
$(1-\theta)g_m$	0.81	-1.16	-1.09	0.17	-1.75*	-0.79	-0.65
	(1.01)	(0.85)	(0.91)	(1.09)	(0.98)	(1.07)	(1.03)
$\ln p_{m0}$	0.49*	-0.04	-0.20	-0.15	-0.71	-0.13	-0.23
	(0.29)	(0.10)	(0.36)	(0.40)	(0.50)	(0.60)	(0.62)
$\ln(1+p_{f0}/p_{m0})$	-1.71	-0.07	1.63***	0.66	0.10	0.33	0.17
	(1.05)	(0.07)	(0.39)	(0.46)	(0.20)	(0.37)	(0.36)
g_w	1.91***	0.95*	0.75	1.43**		1.87***	1.76***
	(0.67)	(0.51)	(0.56)	(0.65)		(0.65)	(0.63)
$\ln W_0$	1.51**	0.78***	0.83**	0.58		1.95***	1.91***
	(0.76)	(0.17)	(0.33)	(0.37)		(0.58)	(0.62)
g_n	-2.06***	-0.41	-0.10	-0.58		-1.14	-1.00
	(0.65)	(0.70)	(0.81)	(0.95)		(0.80)	(0.84)
$\ln N_0$	-1.54**	-0.79***	-1.03***	-0.64		-1.97***	-1.93***
	(0.76)	(0.17)	(0.38)	(0.40)		(0.57)	(0.60)
Δs	0.03	-0.00	-0.06	-0.00			-0.03
	(0.03)	(0.04)	(0.04)	(0.04)			(0.05)
s_0	0.06***	0.03***	0.02	0.02			0.01
	(0.02)	(0.01)	(0.02)	(0.02)			(0.03)
$H_0 : \beta^{g_f} = 1$	0.38	0.43	0.65	0.99	0.33	0.28	0.40
$H_0 : \beta^{gap} = 1 - \beta^y$	0.07	0.02	0.01	0.41	0.62	0.61	0.96
Gender Accounting	0.02	0.00	0.01	0.73	0.07	0.58	0.60
Observations	127	635	635	635	635	635	635
Countries	127	127	127	127	127	127	127
Hansen-J (p-value)					.07	.26	.24
Kleibergen-Paap F					55.53	55.53	50.13

Robust standard errors in parentheses. All columns control for time fixed effects. Columns 3 to 7 control for country fixed effects and errors are clustered at the level of countries. Columns 1 and 2 control of region fixed effects. Columns 1, 2 and 3 pertain to the long differences, Pooled OLS and Fixed Effects models, respectively. Column 4 pertains to the bootstrap-based bias corrected fixed effect proposed by Everaert and Pozzi (2007) with general heteroskedasticity and burn-in initialization. Columns 5 to 7 pertain to the one-step system GMM with first lags as collapsed instruments. $H_0 : \beta^{g_f} = 1$ is the p-value for the test with this null hypothesis. The same for $H_0 : \beta^{gap} = 1 - \beta$. Gender Accounting is the p-value for the test where the null is $\beta^{g_f} = \beta^{g_m} = 1$ and $\beta^{gap} = \beta^{p_m} = 1 - \beta$ jointly. All Accounting is the p-value for the test where the null is $\beta^{g_f} = \beta^{g_m} = \beta^{g_w} = -\beta^{g_n} = 1$ and $\beta^{gap} = \beta^{p_m} = \beta^{W} = -\beta^{N} = 1 - \beta$. *, **, and *** denote significance at 0.1, 0.05 and 0.01, respectively.

create a *gender bonus*, but no secondary bonuses.

We may fail to reject that gender variables have only accounting effects because we add the main mechanisms for a secondary bonus as covariates. In that way, the coefficients associated with FLFP would never "absorb" the effects of education or fertility changes. In Column 5 of Table 1, we estimate a model with a constant population and only raw labor in the production function. Column 6 adds population growth. The coefficients associated with the FLFP do not change significantly across the three models, neither the main conclusions. The only significant change is a stronger negative effect of the growth MLFP on economic growth. Combined, the analysis of the Columns 5-7 provides no support for a secondary bonus through education or population growth.

4 Conclusion

The results presented in this paper highlight the importance of women empowerment for development, specifically in the form of growth of FLFP. We cannot reject that this effect is the result of more workers in market production. Importantly, we find no evidence, however, of secondary bonuses in the form of education or population growth.

It is noteworthy that we only investigate gender inequality in the labor market, whereas inequalities in access to education are another important dimension for economic development. In our empirical exercise, we add years of schooling as covariates such that the effects of gender inequalities in education are captured by the dynamics of human capital. In that way, we focus exclusively on the labor market participation.

References

Baerlocher, D., Parente, S. L., and Rios-Neto, E. (2019). Economic effects of demographic dividend in Brazilian regions. *The Journal of the Economics of Ageing*, 14:100198.

Bandiera, O. and Natraj, A. (2013). Does Gender Inequality Hinder Development and Economic Growth? Evidence and Policy Implications. *The World Bank Research Observer*, 28(1):2–21.

Barro, R. J. and Lee, J. W. (2013). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, 104:184–198.

Barro, R. J. and Sala-i Martin, X. (1997). Technological diffusion, convergence, and growth. *Journal of Economic growth*, 2(1):1–26.

Bazzi, S. and Clemens, M. A. (2013). Blunt instruments: Avoiding common pitfalls in identifying the causes of economic growth. *American Economic Journal: Macroeconomics*, 5(2):152–86.

Benhabib, J. and Spiegel, M. M. (1994). The role of human capital in economic development evidence from aggregate cross-country data. *Journal of Monetary economics*, 34(2):143–173.

Bloom, D. E. and Williamson, J. G. (1998). Demographic transitions and economic miracles in emerging asia. *The World Bank Economic Review*, 12(3):419–455.

Caselli, F. (2005). Accounting for cross-country income differences. In Aghion, P. and Durlauf, S. N., editors, *Handbook of Economic Growth*, volume 1, part A, pages 679 – 741. Elsevier.

Cavalcanti, T. and Tavares, J. (2016). The output cost of gender discrimination: A model-based macroeconomics estimate. *The Economic Journal*, 126(590):109–134.

Cohen, D. and Leker, L. (2014). Health and education: Another look with the proper data.

Cohen, D. and Soto, M. (2007). Growth and human capital: Good data, good results. *Journal of economic growth*, 12(1):51–76.

Cuaresma, J. C., Lutz, W., and Sanderson, W. (2014). Is the demographic dividend an education dividend? *Demography*, 51(1):299–315.

Cuberes, D. and Teignier, M. (2016). Aggregate effects of gender gaps in the labor market: A quantitative estimate. *Journal of Human Capital*, 10(1):1–32.

Everaert, G. and Pozzi, L. (2007). Bootstrap-based bias correction for dynamic panels. *Journal of Economic Dynamics and Control*, 31(4):1160–1184.

Gaddis, I. and Klasen, S. (2014). Economic development, structural change, and womens labor force participation. *Journal of Population Economics*, 27(3):639–681.

Hall, R. E. and Jones, C. I. (1999). Why do some countries produce so much more output per worker than others? *Quarterly Journal of Economics*, 114(1):83–116.

Hsieh, C.-T. and Klenow, P. J. (2010). Development accounting. *American Economic Journal: Macroeconomics*, 2(1):207–23.

Klasen, S. (2018). The impact of gender inequality on economic performance in developing countries. *Annual Review of Resource Economics*, 10:279–298.

Klasen, S. (2020). From 'metoo' to boko haram: A survey of levels and trends of gender inequality in the world. *World Development*, 128:104862.

Klasen, S. and Lamanna, F. (2009). The impact of gender inequality in education and employment on economic growth: new evidence for a panel of countries. *Feminist economics*, 15(3):91–132.

Kleibergen, F. and Paap, R. (2006). Generalized reduced rank tests using the singular value decomposition. *Journal of econometrics*, 133(1):97–126.

Lee, R. and Mason, A. (2006). What is the demographic dividend? *Finance and Development*, 43(3):16.

Nelson, R. R. and Phelps, E. S. (1966). Investment in humans, technological diffusion, and economic growth. *American Economic Review*, 56(1/2):69–75.

Nickell, S. (1981). Biases in dynamic models with fixed effects. *Econometrica*, pages 1417–1426.