Services or the Factory: Women's Work and Industrialization

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Abstract: This paper presents a theory of industrialization where the type of work women do affects the state of industrialization in the economy. Industrialization is modeled as an expansion of a capital-using sector which has a negative income effect on landowners. This, in turn, has a negative effect on the demand for services done by women. The size of this negative income effect is larger for economies with bigger land-to-labor ratios. When this negative income effect is large enough, multiple equilibria are possible: one where women work in services and one where women work in manufacturing. Interestingly, women's wages are higher in the service equilibrium. This points to the interesting implication that for an economy currently at the low-industrialization equilibrium, moving to a high-industrialization equilibrium may lower women's wages. Also, a policy to promote industrialization may entail lowering women's wages by taking employment opportunities away from women in the short run. The model can be used to think about the effects of foreign guest worker programs and the sex industry.

JEL Codes: O10, O12, O14

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1 Introduction

In the Philippines, a large proportion of the female labor force is employed as household servants or in other unskilled service jobs. A large proportion of men work in traditional production using little capital. This pattern is common to a number of developing countries. In contrast, the experience of "export-led growth" in many of the recently industrializing Asian economies was characterized by labor-intensive, light manufacturing industries during the early phase of the countries' development. In these countries, a high proportion of women worked in export industries like textiles. The employment share of female labor in textiles was high during this early phase, exceeding the employment share of female labor across all industries. For example, in Korea in 1985, women made up 67% of the labor force in textiles but only 40% of the total labor force, in Hong Kong in 1985, women made up 62% of textile employment but only 36% of the labor force. (See Tables 1-3). The trend for other light manufacturing export industries like consumer electronics is similar to that of textiles.

This paper presents a theory of industrialization in which the type of work that women do affects the industrialization paths of their countries. Specifically, women working mostly in services and little in manufacturing creates forces that reinforce a low-industrialization state. By contrast, women mostly working in manufacturing and little in service industries also creates forces that reinforce a high-industrialization state. We suggest that the different growth paths of the fast-growing Asian countries and relatively slower-growing developing countries like the Philippines are greatly affected by the work that women do.

What is the mechanism relating women's work and industrialization? First, we observe that foreign capital for light-manufacturing export industries is attracted by low wages. Because in most societies, women are paid lower wages

than men, low women's wages are crucial to attracting foreign capital. Once foreign capital invests in these light-manufacturing industries, women facilitate industrialization in another important way. For various reasons, women tend to sort into low-skilled downstream jobs like assembly. [1] Men, by contrast, are more likely to work in separate complementary jobs that allow them to accumulate productive human capital.

Take, for example, a textile plant where imported machines are used by the women workers to produce the output. The employment of these machines spawns a host of new activities that are generally done by men. The presence of foreign capital creates jobs in repair, servicing, or the provision of supplies. Men in these jobs acquire useful technical knowledge that can be applied to other types of production in the future. Other jobs complementing the assembly work done by women include plant management and other skilled positions which also tend to be held by men. These types of jobs provide human capital either through learning-by-doing or by working alongside foreign counterparts.[2] The jobs providing human capital accumulation complement the assembly jobs done by women and thus are available to the men only because of the low wages paid

[1] One possible reason for the high share of female labor employment in the export industries is the fact that women receive a lower wage than men. This is well documented in the development literature. For a study of the Korean case, see Lee and McElwain (1986). And for the case of Taiwan, see Kao, Polachek, and Wunnava (1994), and Zveglich, Jr., Rodgers, and Rodgers, III (1997). A closely related trend which may also be a cause of the gender wage gap is the segregation of men and women into different types of jobs. Polachek (1981) showed that because of the discontinuous work life of the female worker, and depreciation of human capital, women will self-select into jobs where human capital is not important and men will self-select into jobs where human capital is important. In Asian countries where cultural norms are such that young women tend to work up to the time they marry. They then join the husbands' families and exit the labor force to bear and raise children. If these women do return to the labor force, it would not be for a number of years. This cultural practice also means that families will tend to invest more in the human capital of the son since the daughter would leave to join her husband's family upon marriage. This would also have the effect of driving down women's wages. For other explanations of the gender wage gap, see Blau, Ferber, and Winkler (1998).

[2] See Van and Wan (1999) for a discussion on the mechanism for human spillover in export industries.

to the women.

Alternatively, when women's wages are higher, all else equal, less foreign capital flows to the country and women mostly work in the service sector where there is little human capital accumulation for women. But women's work in the service sector also negatively affects the men's opportunity to accumulate human capital. Consider the situation where there are two technologies to produce one manufacturing good: one capital-using and one land-using. If most of the women work in the service sector, few are working in the capital-using sector (the alternative employer of women). This means there are few men working in the this capital-using sector in those jobs complementary to women's jobs. Therefore, men will have less opportunity to acquire human capital.

In this paper, we show that both the higher-industrialization and the lower-industrialization states are stable equilibria. The key feature to the model presented below is the negative income effect that industrialization has on landowners. Expansion of the capital-using activity (what we call industrialization) causes a contraction of the land-using activity lowering land incomes. When the negative income effect is big enough, more women working in services could actually mean higher women's wages as this would mean a smaller capital-using (women-employing) sector and a larger land-using (non-women-employing) sector. Hence, a large service sector means higher women's wages paid in that sector and thus women prefer to work there over employment in the capital-using sector. The opposite is also true. A small service sector (large capital-using sector, small land-using sector) means lower land incomes and a lower wage paid to women in services. When this negative income effect is large enough, further reduction of the women employment in the services sector means a lower wage paid to women in that sector and hence a small

service sector is consistent with lower wages paid there than in the capital-using manufacturing sector and thus women prefer to work in manufacturing.

One interesting note is that women's wages are lower in the high-industrialization equilibrium. Thus, if there are multiple equilibria and the economy is currently at the low-capital equilibrium, moving the economy to the high-capital equilibrium (industrialization) may actually *lower* women's wages, at least in the short run.[3] This suggests that not only is women, through the type of work that they do, crucial to a country's industrialization, but even more specifically, that industrialization in this context requires women to have lower wages as an initial condition. This general theme has been discussed before by other researchers. Notable examples include Fogel and Engerman's (1974) study of slavery and American industrialization and Nardinelli's (1990) work on child labor and the industrial revolution. The theory presented in this paper differs in that it implicitly considers the positive positive spillovers in manufacturing activity while much of the work on slavery and child labor in industrialization have focused more on the larger surplus when labor is cheap.

The rest of this paper is organized as follows. In the next section, we present a model of industrialization capturing the ideas discussed above. Section 3 discusses the equilibrium in the model and conditions under which there are possibly multiple equilibria: low-industrialization equilibrium where women work in household services and a high-industrialization equilibrium where women are employed in manufacturing. Section 4 presents a dynamic extension to the model in which we show that there are two steady states—the dynamic analog to the multiple equilibria in the previous section. We use an endogenous

[3]Women's wages fall initially but would rise from that point on when growth in manufacturing is sustained.

growth set up to show that the modern manufacturing sector needs to reach a sufficient size in order for the economy to move to the high-industrialization steady state. Section 5 concludes with remarks about policy and alternative applications of the model.

2 The Model

2.1 Production

A small open economy can produce a single manufacturing good, x, traded freely in the world market. Production of this good can be accomplished using either a traditional land-using technology or a modern capital-using technology. The traditional technology uses land and male labor while the modern technology uses capital and both male and female labor. There are T landowners each endowed with 1 unit of land. Each landowner employs male workers, m_1/T, to work on this land. Assume T is large enough that markets are competitive and we can represent output, x_1, of the traditional manufacturing sector as coming from a single representative firm:

$$x_1 = g(T, m_1),$$

where the production function $g(\cdot)$ is constant returns to scale in the inputs. Since land has only one use, henceforth, we write $g(T, m_1) = g(m_1)$, $g'(m_1) > 0$ and $g''(m_1) < 0$. The manufacturing good can also be produced by many firms each using an alternative capital-using technology that employs capital, K, and an intermediate labor input, L. Output in this modern manufacturing sector, x_2, can also be represented as coming from one representative firm:

$$x_2 = Ah(K, L), \tag{1}$$

where A is a productivity parameter and $h(\cdot)$ is constant returns to scale in K and L. The intermediate labor input, L, is the output of men and women working together. We assume the male and female labor are perfect complements so that L is the output of a Leontief technology

$$L = \min\{bm_2, f_2\},$$

where $b > 1$ is the optimal ratio of women to men employed in sector 2, f_2/m_2. The assumption that male and female labor are perfect complements is strictly for convenience and ease of presentation. The qualitative results of this paper would all go through for a technology with some substitution between male and female labor. This specification captures the idea that men get to work in the modern manufacturing sector only if women work there. The motivation for the segmentation in the jobs done by men and those done by women was discussed in the previous section.

We model the capital-using sector employing women while the land-using sector does not. This is an extreme assumption for ease of exposition. An alternative specification that would yield the same results would be that the capital-using sector employs women more intensively than the land-using sector. A similar idea is presented in Galor and Weil (1996) where capital is assumed to complement women more than it does men.

For simplicity, capital is assumed to be owned by foreigners and returns accrue to them. In this small economy where capital flows freely across borders, the return to capital will equal to the world return, $r = r^*$. Goods x_1 and x_2 are indistinguishable and thus $x = x_1 + x_2$. Take x to be the numeraire.

There is a household services sector. Production of household services, z, employs only female labor as input and follows the simple specification $z = f_3$,

where f_3 is the level of female employment in this activity. Thus, the price of household services will exactly equal female wage, $p_z = w_f$.

In the traditional land-using sector, men's wages, w_m, and land rents, w_t, are equal to the marginal products of labor and land:

$$w_m = g'(m_1),$$
$$w_t = \frac{g(m_1)}{T} - \frac{m_1}{T} g'(m_1).$$

The first order necessary conditions for the modern capital-using manufacturing sector are:

$$w_f + \frac{w_m}{b} = A \frac{\partial h(K, L)}{\partial L},$$
$$r = A \frac{\partial h(K, L)}{\partial K}.$$

2.2 Consumers

There are two classes of households: landowners and laborers. The landowning households receive rent from their landholding at a rate of w_t per unit of land. Landowners do not work.

There are N laboring households, each made up of one man and one woman. Each member is endowed with one unit of labor and supplies it in the labor market inelastically. Wages are w_m and w_f for the man and woman, respectively. Men work in either the modern or traditional manufacturing sectors, $m_1 + m_2 = N$, and women work in either the modern manufacturing or service sector, $f_2 + f_3 = N$.

Households derive utility from consuming the manufacturing good, x, and household services, z. The utility function is additively separable in x and z and is

non-homothetic:

$$u(x,z) = \alpha \log\left(z + \frac{a}{1-\alpha}\right) + (1-\alpha)\log x,$$

where a is a parameter. For sufficiently low incomes, consumption of household services, z, is zero and is only positive for household incomes beyond some threshold. Figure 1 shows the indifference curve maps and income expansion path for this utility specification.

Each household's maximization problem is the following:

$$\begin{aligned} \max_{x,z} \quad & \left\{\alpha \log\left(z + \frac{a}{1-\alpha}\right) + (1-\alpha)\log x\right\} \\ \text{subject to} \quad & p_z z + x = I, \end{aligned}$$

where I denotes household income. Income for laboring households is $I = w_f + w_m$ while income of each landowner $I = w_t$. Demand from landowners for the consumption good and household services, x_T and z_T, are:

$$z_T = \begin{cases} 0, & \text{for } \frac{\alpha w_t}{p_z} < a \\ \alpha\frac{w_t}{p_z} - a, & \text{for } \frac{\alpha w_t}{p_z} \geqslant a \end{cases}$$

$$x_T = \begin{cases} w_t, & \text{for } \frac{\alpha w_t}{p_z} < a \\ (1-\alpha)w_t + p_z a, & \text{for } \frac{\alpha w_t}{p_z} \geqslant a. \end{cases}$$

For certain ranges of parameter values, incomes of laborers will be low enough that laborers never consume z in equilibrium and spend their entire incomes on the consumption good x. We derive conditions on parameter values for which

this is true in the appendix. Total demand can be written as follows:

$$z^D = Tz_T = \begin{cases} 0, & \text{for } \frac{\alpha w_t}{p_z} < a \\ \alpha \frac{w_t T}{p_z} - aT, & \text{for } \frac{\alpha w_t}{p_z} \geqslant a \end{cases}$$

$$x^D = Nx_L + Tx_T = \begin{cases} N\left(\frac{w_f}{b} + w_m\right) + Tw_t & \text{for } \frac{\alpha w_t}{p_z} < a \\ N\left(\frac{w_f}{b} + w_m\right) + T((1-\alpha)w_t + p_z a) & \text{for } \frac{\alpha w_t}{p_z} \geqslant a. \end{cases}$$

3 Equilibrium

A general equilibrium in the economy is defined as the set
$(p_z, w_t, r, w_f, w_m, m_1, m_2, f_2, f_3, K)$ solving the following system of equations:

$$w_m = g'(m_1); \tag{2}$$

$$w_t T = g(m_1) - m_1 g'(m_1); \tag{3}$$

$$w_f + \frac{w_m}{b} = A\frac{\partial h(K,L)}{\partial L}; \tag{4}$$

$$r = A\frac{\partial h(K,L)}{\partial K}; \tag{5}$$

$$r = r^* \tag{6}$$

$$m_2 = \frac{f_2}{b} = L; \tag{7}$$

$$f_3 = \alpha\frac{w_t T}{p_z} - aT; \tag{8}$$

$$p_z = w_f; \tag{9}$$

$$f_2 + f_3 = N; \tag{10}$$

$$m_1 + m_2 = N. \tag{11}$$

Since good x is traded freely in the world market and this is a small economy, market-clearing for good x is trivial and not included in the above system of equations. The marginal product of capital is set by the world return, r^*. Since $h(\cdot)$ is constant returns to scale, we can write equation (5) as a function of the capital-labor ratio, $r^* = Ah'(K/f_2)$. Thus the capital-labor ratio in the capital-using sector is determined by the world return and thus the wage paid to the intermediate input is also a function of r^*. Combining with equation (4), we can write

$$w_f + \frac{w_m}{b} = w_L(r^*, A), \tag{12}$$

where

$$w_L(, r^*, A) \equiv A\frac{\partial h(\frac{K}{L}(r^*, A))}{\partial L}.$$

Men's wages are determined in sector 1 as given in equation (2). Substituting equations (7, 11, and 2) into the above gives the following relationship between w_f and f_2:

$$w_f = w_L(r^*, A) - \frac{g'(N - f_2/b)}{b}. \tag{13}$$

Denote the locus (w_f, f_2) that satisfies equation (13) as MM. This MM is the inverse demand function for female labor in sector 2 taking into account the effect that employment of female labor has on male wages. The MM curve is downward sloping,

$$\frac{dw_f}{df_2} = \frac{g''(N - f_2/b)}{b}.$$

The idea is the following. All else equal, suppose there is an infusion of capital into the modern sector. This increases the demand for both female and male labor proportionately since the capital-labor ratio is fixed by the exogenous world return. Male wages rise as male labor is drawn away from sector 1, raising labor's marginal product there. Since the wage paid to the intermediate labor input is a

function of the capital-labor ratio, it is fixed. Thus the wage paid to women in sector 2 actually falls. The extent of the fall in women's wage depends on the curvature of the production function representing the land-using sector. More precisely, it depends on the sign of $g'''(m_1)$. The MM curve is drawn in Figures 2, 3, and 4.

Turn now to the demand for female labor in household services. Substitute equations (3, 7, 10 and 11) into equation (8) to get:

$$w_f = \frac{\alpha(g(N - f_2/b) - (N - f_2/b)g'(N - f_2/b))}{N - f_2 + aT}. \tag{14}$$

Denote the (w_f, f_2) pairs satisfying equation (14) as SS. The SS curve is the inverse demand function for female labor in household services (sector 3) when the effect of female employment on the income of landowners is taken into account.

To understand some of the properties of the SS curve, first, consider its slope:

$$\left.\frac{dw_f}{df_2}\right|_{SS} = \frac{\alpha(g - (N(1 - 1/b) + aT)g' + 1/b(N - f_2/b)g'')}{(N - f_2 - aT)^2}. \tag{15}$$

Note that the last two terms in the numerator are negative while g is positive. Furthermore, g' increases with f_2 while g falls with f_2. Thus, for high values of f_2 (possibly $> N$), the SS curve is downward sloping. For low values of f_2 (possibly negative), the SS curve slopes upward. The SS peaks at some intermediate value, call $\tilde{f}_2$. We are interested in the shape of the SS curve for $f_2 \in (0, N)$.

Proposition 1. *If $\frac{T}{N}$ is sufficiently large, the SS curve slopes downward for $f_2 \in (0, N)$; if $\frac{T}{N}$ is sufficiently small, the SS curve slopes upward for $f_2 \in (0, N)$; if $\frac{T}{N}$ falls into some intermediate range of values, the SS curve first slopes upward then downward for $f_2 \in (0, N)$.*

Proof. See appendix. □

The wage, w_f, landowners are willing to pay for some level of services $f_3(= N - f_2)$ depends on the landowners' income, which is also a function of f_2. A lower level of demand for household services, $f_3(= N - f_2)$ implies a higher f_2 which is consistent with a smaller land-using sector and less income for landowners. The demand wage, w_f, depends on the ratio of landowner income to $N - f_2 + aT$. Whether w_f rises or falls with the rise in f_2 depends on the relative size of the effects on these two quantities and thus the size of the negative income effect on land incomes.

To better understand Proposition 1, make the normalization $N \equiv 1$. The variables m_1, m_2, f_2, and f_3 now take on values between zero and one. For smaller T the flatter is $g(T, m_1)$ as a function of m_1. A contraction of sector 1 brought about by reducing employment, m_1, corresponds to a smaller drop in the return to land. In other words, landowners see less of a drop in income for a reduction in m_1 and correspondingly in quantity of f_3 demanded. For a sufficiently small $\frac{T}{N}$, the drop in land incomes is small enough that the demand price for female labor increases with decreasing demand. That is w_f falls with increasing f_3 or rises with increasing $f_2(= N - f_3)$ along the SS curve. This case is shown in Figure 2.

Similarly, when $\frac{T}{N}$ is sufficiently large, the drop in land incomes for a unit reduction in m_1 will be sufficiently large, that a reduction in the demand for household services (decreasing f_3) leads to a fall in the demand price for women's services, w_f. This is shown in Figure 4.

When $\frac{T}{N}$ is in some intermediate range, the SS curve peaks at $\tilde{f}_2 \in (0, N)$. Start from a point with a small capital-using sector, thus a large land-using sector since most men are now working in the latter. An increase in f_2 will draw men out of the land-using sector and reduce land incomes. However, when the land-using

sector is large, the drop in land incomes may not be very large so that w_f would rise with f_2. As the capital-using sector expands further, the land-using sector will get sufficiently small that further shrinkage leads to a drop in land income great enough that w_f falls with f_2. For this higher range of f_2, w_f falls with increasing f_2. See Figure 3.

The intuition for Proposition 1 is the following. To restate the above a little differently, the relationship between the wage paid and the level of household services demanded is a typical downward-sloping curve. A reduction in the employment of women in household services has two effects however. First, it corresponds to higher demand wage as we move up the demand curve. Second, it has a negative income effect on land incomes as the lower level of employment in household services means more women are working in the capital-using sector, and it also means more men are working in this same sector, which means less men are working in the land-using sector. The contraction in the land-using sector lowers land incomes lowering the demand curve for household services. The negative income effect could in principle shift the demand curve down enough that the net effect of a lower level of employment in household services is a *lower* demand wage for household services.

In an economy that is sufficiently labor abundant, small $\frac{T}{N}$, a unit reduction in employment in the land-using sector will not have a great impact on land incomes. Thus the negative income effect on landowners from a contraction in the land-using sector will be small and so lower employment in household services would still correspond to a higher demand wage. In an economy that is sufficiently labor scarce, a large $\frac{T}{N}$, a unit reduction in employment in the land-using sector will cause land incomes to fall enough that demand for household services will shift downward enough that the wages landowners are

willing to pay to women will fall with a lower level of household services demanded.

In an economy where the the land-labor ratio is somewhere in between, whether the land income effect is sufficiently large for women wages to fall with lower household services demanded depends on the actual size of the land-using sector. When the land-using sector is small, the reduction in land incomes will be significant enough for additional contractions in this sector. When the land-using sector is large, the reduction in land incomes will not be significant for further contractions. This follows from the concavity of $g(\cdot)$.

3.1 Economies that are labor-abundant: the case of small $\frac{T}{N}$

For economies characterized by a sufficiently small land-labor ratio, $\frac{T}{N}$, the SS curve slopes upward. There will be a unique equilibrium in this economy. For a sufficiently unproductive modern manufacturing sector, represented by a low value of A, women's wages paid in the modern manufacturing sector are lower than that paid in household services. All women work in household services where women's wages are determined by the SS curve. When the modern manufacturing sector is sufficiently productive (A sufficiently high), women's wages in this sector exceed that paid in household services and all women work in manufacturing. In some intermediate range of values for A, both the modern manufacturing sector and household services sector exist. The number of women working in each of the sectors is determined by the intersection of the MM and SS curves as shown in Figure 2.

The effect of productivity gains in the capital-using manufacturing sector on women's wages can be stated in the following proposition.

Proposition 2. *For a sufficiently low $\frac{T}{N}$, as the parameter A increases beyond the point*

where the capital-using modern manufacturing sector comes into existence, women's wages rises monotonically.

Proof. Can be seen from Figure 2. □

As the economy industrializes because of the rise in manufacturing productivity, women's wages rise. The rate of increase in women's wages is smaller at first as some of the increase in the marginal product of labor in the capital-using sector goes to increasing men's wages. Beyond the point where the household service sector disappears, the point also where sector 1 reaches its minimum size, men's wages reach a maximum. Thus subsequent productivity gains all translate to gains in women's wages.

3.2 Economies that are labor-scarce: the case of large $\frac{T}{N}$

When $\frac{T}{N}$ is sufficiently large, the SS curve slopes downward. Here, there are two possibilities. First, consider the case where the MM curve is steeper than the SS. The results for the employment of women are similar to the case with small $\frac{T}{N}$. When the capital-using modern manufacturing sector is sufficiently unproductive (low A), all women work in household services and the modern manufacturing sector is non-existent. When productivity in this sector is sufficiently high (high A), all women work in the modern manufacturing sector. When A falls in some intermediate range, both the modern manufacturing sector and household services sector exist and the number of women working in each of the sectors is determined by the interior intersection of the MM and SS curves.

The effect on women's wages coming from increases in productivity in the capital-using sector is now a little different.

Proposition 3. *For a sufficiently high* $\frac{T}{N}$*, as the parameter* A *increases beyond the point where the capital-using modern manufacturing sector comes into existence, women's wages first falls as women move from household services to manufacturing, then rises after all women have moved out of household services into manufacturing.*

When A is sufficiently low, all women are employed in household services and women's wages are determined by the demand for household services. As A increases beyond the point where the capital-using manufacturing sector becomes viable, the land-using sector contracts as the capital-using sector expands. When $\frac{T}{N}$ is large, the negative income effect on land incomes is large enough that further expansion of the capital-using sector causes the demand for household services to fall enough that women's wages fall. Women's wages continue to fall until the demand for household services disappears completely. Beyond that point, women's wages increase with additional productivity gains.

When the SS curve slopes downward, there is the possibility of multiple equilibria. This occurs when the SS curve is steeper than the MM as shown in Figure 4. When A is in some intermediate range, there are three equilibria, two of which are stable. The two stable equilibria are shown as point S where all women work in household services, and point M where all women work in manufacturing. Consider an employment level to the left of f_{2crit} between points S and M. At this allocation, women's wages in services exceed those in manufacturing inducing women to move out of manufacturing into services. For any allocation to the right of f_{2crit}, women's wages in manufacturing exceed those in services. Women move out of services into manufacturing. The quantity f_{2crit} can be considered a critical size of the modern manufacturing sector above which, the economy will move to a higher level of industrialization and below which, the economy will move to a lower level of industrialization.

One way to think about the results here is that women's wages are *too high* under equilibrium point S, the equilibrium where women work in household services. For a given r^*, no capital investment will be made when women are paid as much as they are in services and thus industrialization does not take place.

The effect of productivity gains in the capital-using sector on women's wages is shown in Figure 5. The interesting result here is that women's wages could actually fall when the economy switches from the equilibrium where all women are employed in services to the equilibrium where all women are employed in manufacturing. However, from equation (12), $w_f + w_m/b = C_1$, a constant. Total income for a laboring household is thus $w_f + w_m = C_1 + (1 - 1/b)w_m$. Since w_m is higher at point M than point S, laboring households are better off in the equilibrium with a higher fraction of women working in manufacturing. Landowners are worse off at C than at A since the land-using sector is smaller in the former.

3.3 The case of when $\frac{T}{N}$ is in some intermediate range

The results here are a hybrid of the results in the previous two sections. Consider the case where the MM curve is more negatively sloped than the SS curve. We will only discuss the effects on women's wages when productivity in the capital-using sector increases.

Proposition 4. *When $\frac{T}{N}$ is in some intermediate range, and when the MM curve is everywhere more negatively sloped than the SS curve, as the parameter A increases beyond the point where the capital-using modern manufacturing sector comes into existence, women's wages first rises as women move from household services to manufacturing, then falls as women continue to move from services into manufacturing, then rises again after all women have moved out of household services into manufacturing.*

This interesting result follows from the fact that wages follow the SS curve for a range of A. Wages first rise when the negative income effect on land income associated with the expansion (contraction) of the capital-using (land-using) sector is small. Wages fall when this negative income effect becomes large enough that it depresses women's wages. For sufficiently high productivity in the capital-using sector, women's wages rise with rising productivity since wages are no longer determined by the SS curve.

In the case where the MM curve is less steep than the negatively-sloped portion of the SS, multiple equilibria are possible. The wage profile in this case is shown in Figure 6. The case is made interesting in that now women's wages could follow two different paths depending on which equilibrium the economy is in. Here, as in the case with a large $\frac{T}{N}$, moving to a high-industrialization equilibrium may actually lower women's wages.

3.4 The effects of varying the world return to capital, r^*

A higher r^* will require a higher return to capital in this economy in order to induce the same level of capital investment. Put differently, this means a lower wage, w_f, is required to induce the same capital investment. The effect is a downward shift of the MM curve. This can be seen algebraicly from equation 13. The SS curve is unaffected by a change in r^*.

Consider a situation where there are multiple equilibria. The effect of an increase in r^* depends on the initial state of the economy. Suppose the economy is at the high industrialization equilibrium. For sufficiently small increases in r^*, the economy will stay in a high industrialization state and employment levels in each sector do not change. This leaves male wages and land returns unchanged. However, women's wages will fall as capital leaves the economy. For sufficiently

large increases in r^*, the MM curve will shift low enough that the high-industrialization equilibrium no longer exists. Women's wages fall sufficiently low in manufacturing that women will move into the services sector. The economy will move to the equilibrium with no (or a small) modern manufacturing sector. Interestingly, women's wages will actually rise as a result. Land incomes rise and male wages fall as the land-using sector expands.

If the economy starts at a point with a small capital-using manufacturing sector, and r^* rises, more women move out of manufacturing into services, both men and women wages fall while land incomes rise as the land-using sector expands. When r^* reaches a sufficiently high level, the land-using sector will reach its maximum size, and the capital-using sector ceases to exist. Since there is no capital-using activity in the economy, further increases in r^* have no effect.

4 Dynamic Extension

[TO BE ADDED]

5 Concluding Remarks

Economies where women work mainly in household services as opposed to manufacturing tend to be less industrialized. The model in this paper seeks an explanation for this where we argue that in such economies, there are forces that tend to reinforce that equilibrium. The same is true for economies where more women work in manufacturing and less services.

When the capital-using activity exhibits positive spillovers (by, for example, learning-by-doing or some mechanism as discussed in Romer (1986)), wages grow as industrialization is sustained whiles wages are stagnant when women

work mostly in services. We have here a story of a development trap. One that fits some empirical regularities in the developing world. For instance, a country like the Philippines may be stuck in a low-industrialization, service equilibrium equilibrium while countries like Taiwan and South Korea may be in the high-industrialization manufacturing equilibrium. What type of work women in these countries do matters to the country's growth path.

Though we built the model presented in this paper in the context of women workers and their participation in the service and manufacturing industries, the model does suggest other applications. More generally, it is not hard to see how this might apply to economies with certain classes of workers that, by history or institutions, do not have access to certain types of jobs. Workers in certain castes or disadvantaged ethnic groups might have only access to unskilled jobs with little human capital gain. They can either work in the service sector or as low-wage manufacturing workers. This paper suggests that the choice of occupation of these workers matters to the performance of the economy. The presence of opportunities in the service sector may actually keep wages too high so that manufacturing industries cannot thrive. It is worth noting again that this does not suggest that industrialization comes at the expense of these workers. When the industrialization process spawned by the lower wages would over time raise wages of these workers when there are productivity gains that accrue with more manufacturing activity.

Some policy implications of this model follow. Policies to improve manufacturing efficiency (shifting the MM curve upward) or to promote more capital investments will promote industrialization. In the case where there are multiple equilibria, and the economy is at an equilibrium where women work in services, a policy to build up a critical size of the modern manufacturing sector

would move the economy to the high-industrialization equilibrium. Paradoxically, that may mean taking away opportunities for women in the service industry. Following such a policy to help raise women's wages in the long-run might actually entail having to lower women's wages in the short run.

The model can also be used as a framework to think about the effect of foreign guest workers. For instance, Filipino maids working in Hong Kong, Mexican workers in the U.S., among others. In the context of the model, this can be thought of as an added exogenous demand for services. An increase in this demand shifts the SS curve upward, driving up wages and making the manufacturing equilibrium harder to attain. If the increase in demand for these unskilled worker from abroad are so great, the high-industrialization equilibrium could disappear altogether. In policy terms, the short-run solution of finding better employment abroad for a country's workers may work to the detriment of industrialization in the long-run. A similar analysis follows when one thinks about the employment of women in the sex-industry in many developing countries.

Appendix

A Proof of Proposition 1

Begin with the relationship describing the SS curve:

$$w_f = \frac{\alpha(g(N - \frac{f_2}{b}) - (N - \frac{f_2}{b})g'(N - \frac{f_2}{b}))}{N - f_2 + aT}.$$

Differentiate with respect to f_2:

$$\left.\frac{dw_f}{df_2}\right|_{SS} = \frac{\alpha(g(N - \frac{f_2}{b}) - [(1 - \frac{1}{b})N + aT]g'(N - \frac{f_2}{b}) + \frac{1}{b}[N - \frac{f_2}{b}]g''(N - \frac{f_2}{b}))}{(N - f_2 - aT)^2}.$$

By inspection, we note that $\frac{d^2 w_f}{d f_2^2} < 0$. The SS curve is concave. Now we want to check if there is a turning point. Setting $\frac{d w_f}{d f_2} = 0$, we have:

$$g\left(N - f_2/b\right) - \left[\left(1 - 1/b\right) N + aT\right] g'\left(N - f_2/b\right) + 1/b\left[N - f_2/b\right] g''\left(N - f_2/b\right) = 0,$$

which we can rewrite as:

$$\begin{aligned}(1 - 1/b)N + aT &= \frac{g(N - \frac{f_2}{b}) + \frac{1}{b}[N - \frac{f_2}{b}]g''(N - \frac{f_2}{b})}{g'(N - \frac{f_2}{b})} \\ \frac{T}{N} &= \Gamma(f_2), \end{aligned} \tag{16}$$

where we define:

$$\Gamma(f_2) \equiv \frac{1}{Na}\left(\frac{g(N - \frac{f_2}{b}) + \frac{1}{b}[N - \frac{f_2}{b}]g''(N - \frac{f_2}{b})}{g'(N - \frac{f_2}{b})}\right) - \frac{1 - 1/b}{a}.$$

Define $\tilde{f}_2$ as that which solves equation (16) should a solution exist. Note that $\tilde{f}_2$ is also the point at which the SS curve reaches a maximum.[4]

Since $g, g', and g''$ are continuous and differentiable, $\Gamma(f_2)$ is continuous and differentiable. By inspection, it is apparent that $\Gamma'(f_2) < 0$ when $g'''(\cdot) > 0$.[5] We can also verify that $\Gamma(f_2 = 0)$ and $\Gamma(f_2 = N)$ are both finite.

From the above, we can draw the following conclusions (see Figure 7 for a graphical depiction):

- if $\frac{T}{N} > \Gamma(0)$ then $\tilde{f}_2 < 0$ so for $f_2 \in (0, N)$, the SS curve slopes downward.
- if $\frac{T}{N} \in (\Gamma(N), \Gamma(0))$ then $\tilde{f}_2 \in (0, N)$.

[4] A solution to equation (16)will not exist if $\lim_{f_2 \to \infty} \Gamma(f_2) > \frac{T}{N}$. In that case, the SS curve will slope upward for all values of f_2.

[5] The assumption that $g'''(\cdot) > 0$ is a sufficient, not necessary, condition to ensure that $\Gamma'(f_2) < 0$. A Cobb-Douglass specification for $g(\cdot)$ would satisfy this condition.

- if $\frac{T}{N} < \Gamma(N)$ then $\tilde{f}_2 > N$ and for $f_2 \in (0, N)$, the SS slopes upward.

For concreteness, consider the Cobb-Douglass example where $g(T, m_1) = T^{\beta} m_1^{1-\beta}$. For this specification,

- the SS curve slopes downward for $f_2 \in (0, N)$ if $\frac{T}{N} < \frac{1}{a} \frac{b-1+\beta}{1-\beta}$
- the SS curve slopes upward for low values of $f_2 > 0$ and downward for high values of $f_2 < N$ if $\frac{T}{N} \in (\frac{1}{a} \frac{b-1+\beta}{1-\beta}, \frac{1}{a} \frac{2(b-1)+\beta}{1-\beta})$
- the SS curve slopes upward for $f_2 \in (0, N)$ if $\frac{T}{N} > \frac{1}{a} \frac{2(b-1)+\beta}{1-\beta}$.

B Sufficient condition for laboring households never consuming z

Laboring households will not consume any household services if:

$$\begin{aligned} \frac{\alpha(w_m + w_f)}{w_f} &< a \\ \frac{w_m}{w_f} &< \frac{a - \alpha}{\alpha} \\ \frac{w_f}{w_m} &> \frac{\alpha}{a - \alpha}.. \end{aligned} \tag{17}$$

Women's wages, w_f, is either the demand wage in the manufacturing sector or in the household services sector, whichever one happens to exist in equilibrium. If the capital-using manufacturing sector operates in equilibrium, then laboring

households will not consume any household services if:

$$\begin{aligned} \frac{w_f|_{MM}}{w_f} &> \frac{a-\alpha}{\alpha} \\ \frac{w_L(r^*) - w_m/b}{w_f} &> \frac{a-\alpha}{\alpha} \\ \frac{w_L(r^*)}{w_f} &> \frac{a-\alpha}{\alpha} + \frac{1}{b}. \end{aligned} \tag{18}$$

That is to say, the marginal product of labor in the capital-using manufacturing sector (the women-employing sector) is sufficiently large relative to the marginal product of labor in traditional manufacturing (the non-women-employing sector).

This is a sufficient condition to guarantee zero demand for z from laboring households since in the equilibrium where the modern manufacturing sector does not exist, it must be true that $w_f|_{SS} > w_f|_{MM}$ so that satisfying inequality (18) implies inequality (17) is satisfied.

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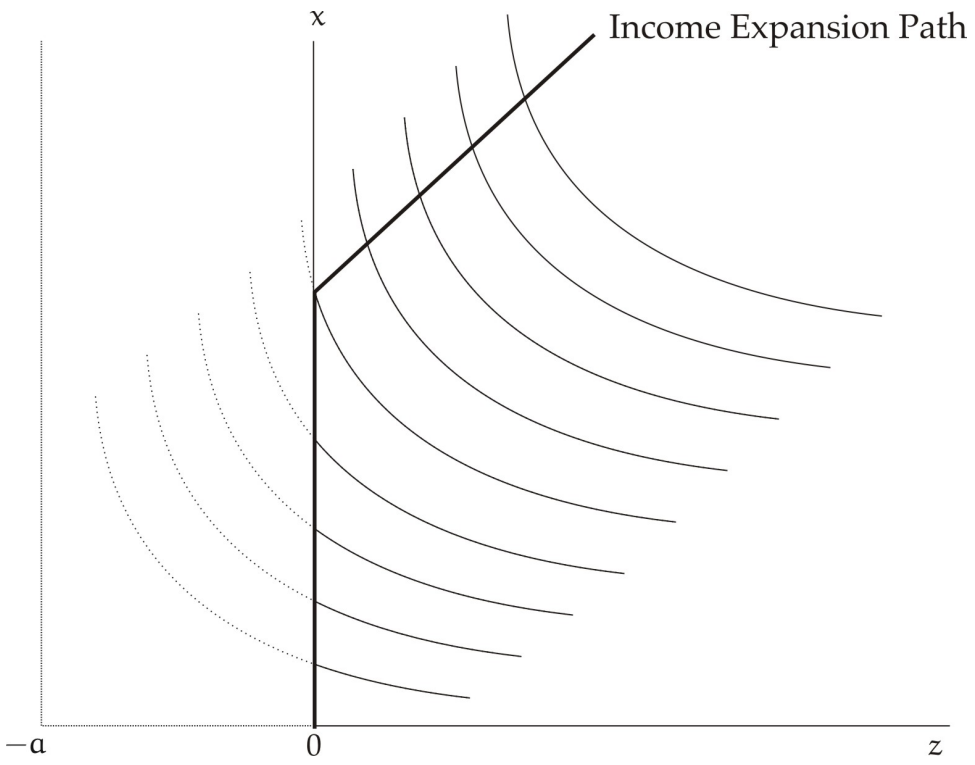

Figure 1

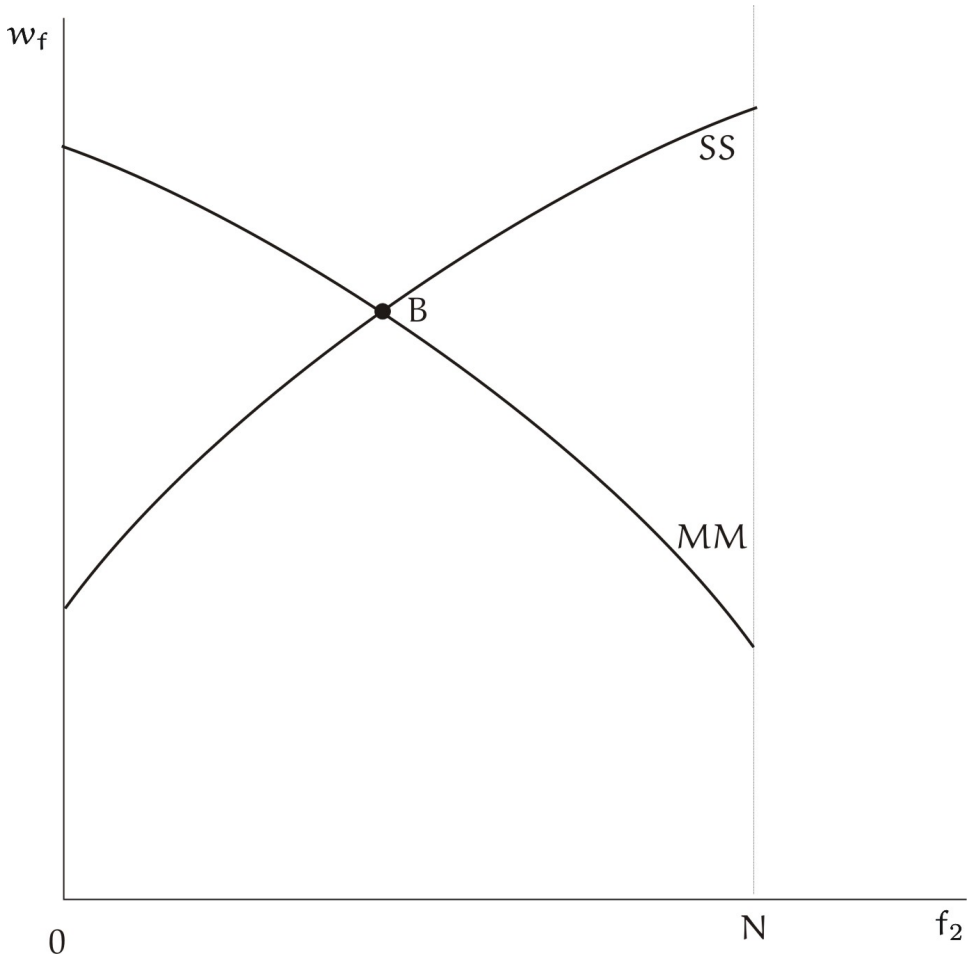

Figure 2. For economies where $\frac{T}{N}$ is sufficiently high, the SS curve slopes upwards; a unique equilibrium exists.

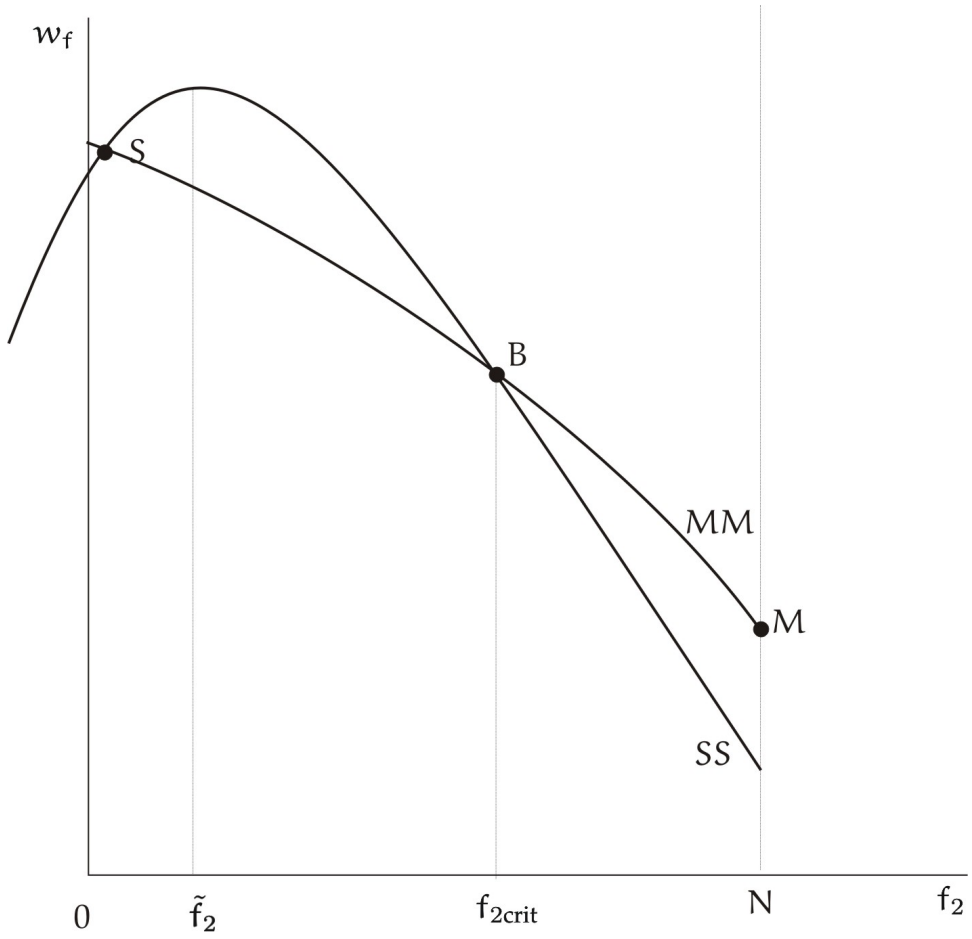

Figure 3. For economies where $\frac{T}{N}$ is in some intermediate range, the SS reaches a maximum point at some $\tilde{f}_2 \in (0, N)$; multiple equilibria is possible.

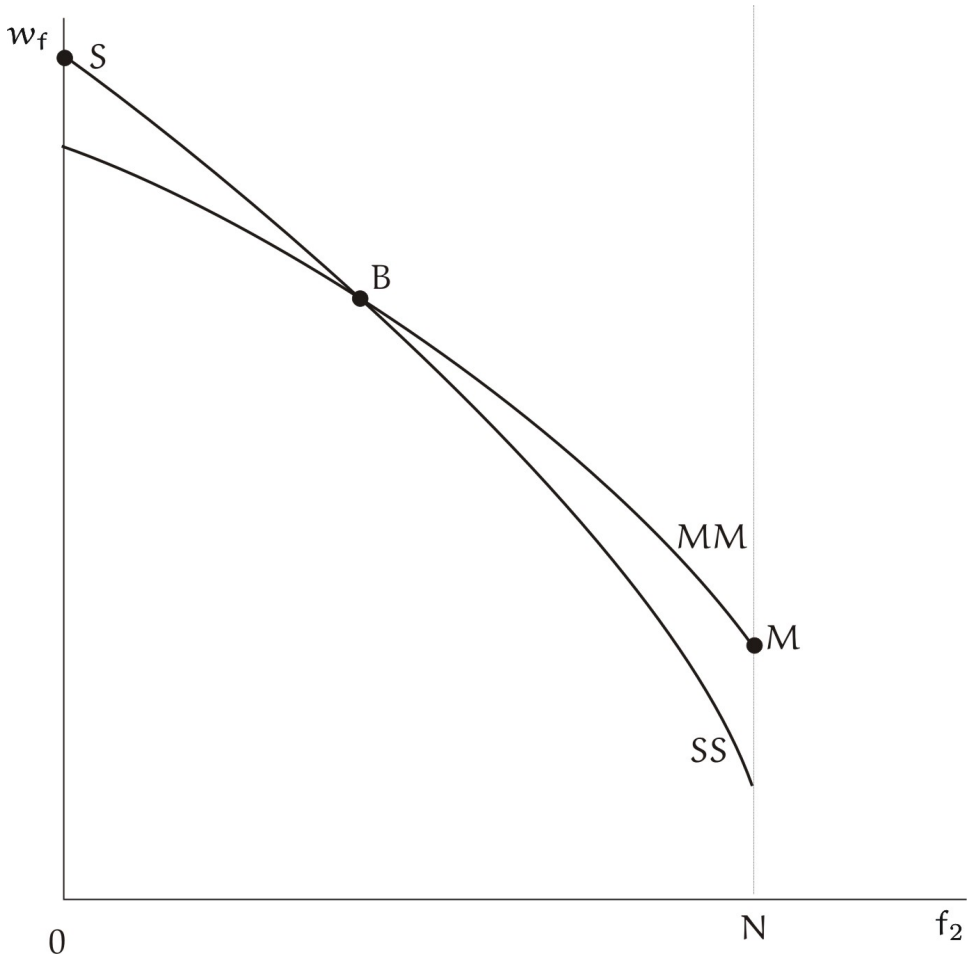

Figure 4. For economies where $\frac{T}{N}$ is sufficiently low, the SS curve slopes downwards; multiple equilibria is possible.

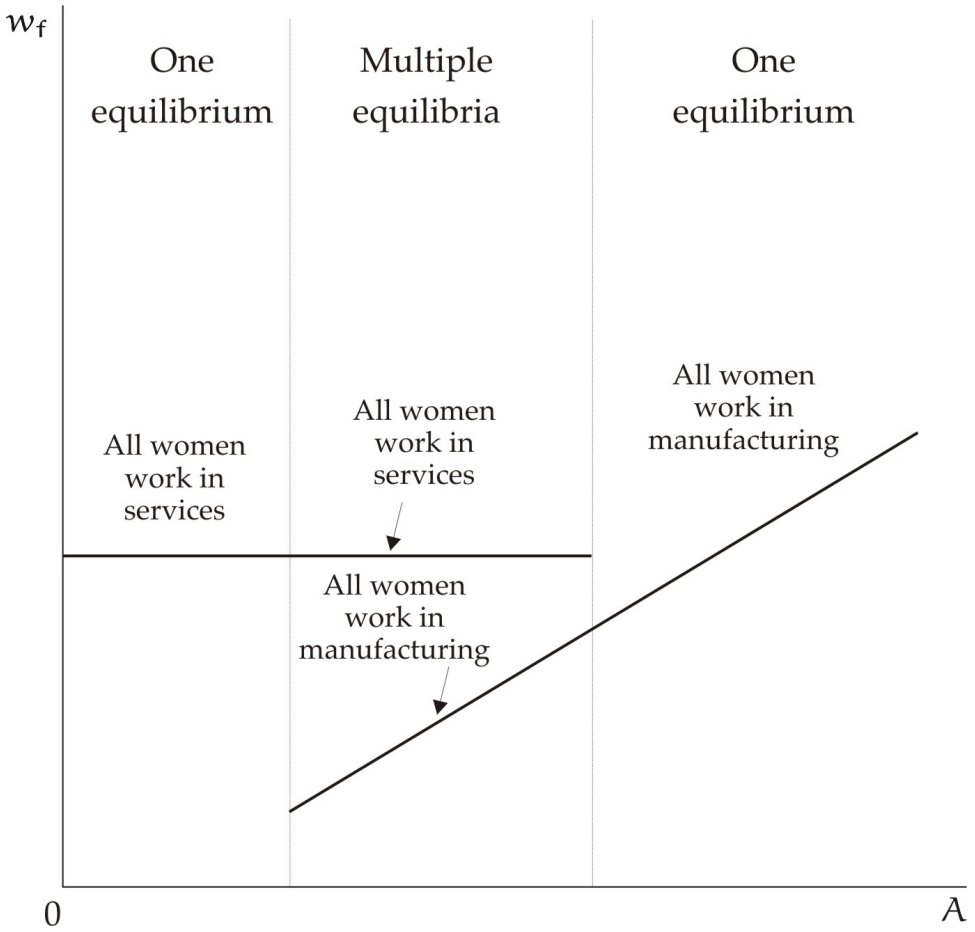

Figure 5. Women's wages and productivity gains in the capital-using manufacturing sector for $\frac{T}{N}$ sufficiently large.

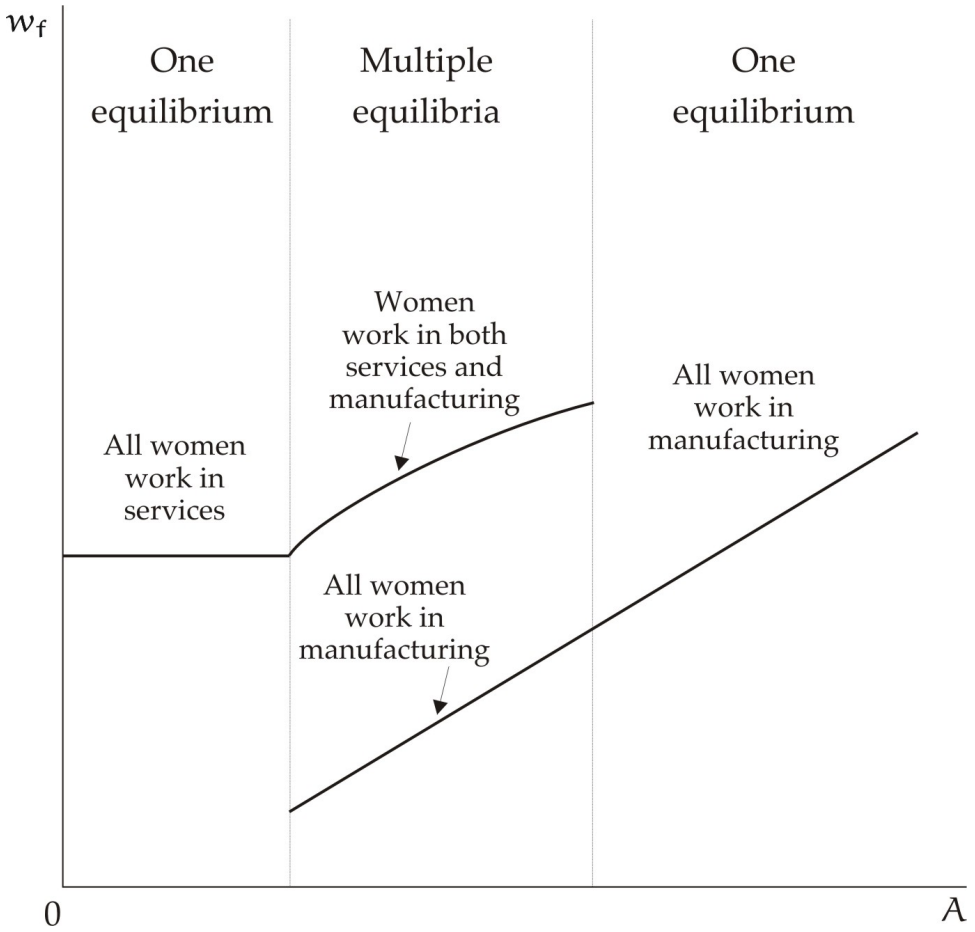

Figure 6. Women's wages and productivity gains in the capital-using manufacturing sector for $\frac{T}{N}$ in some intermediate range.

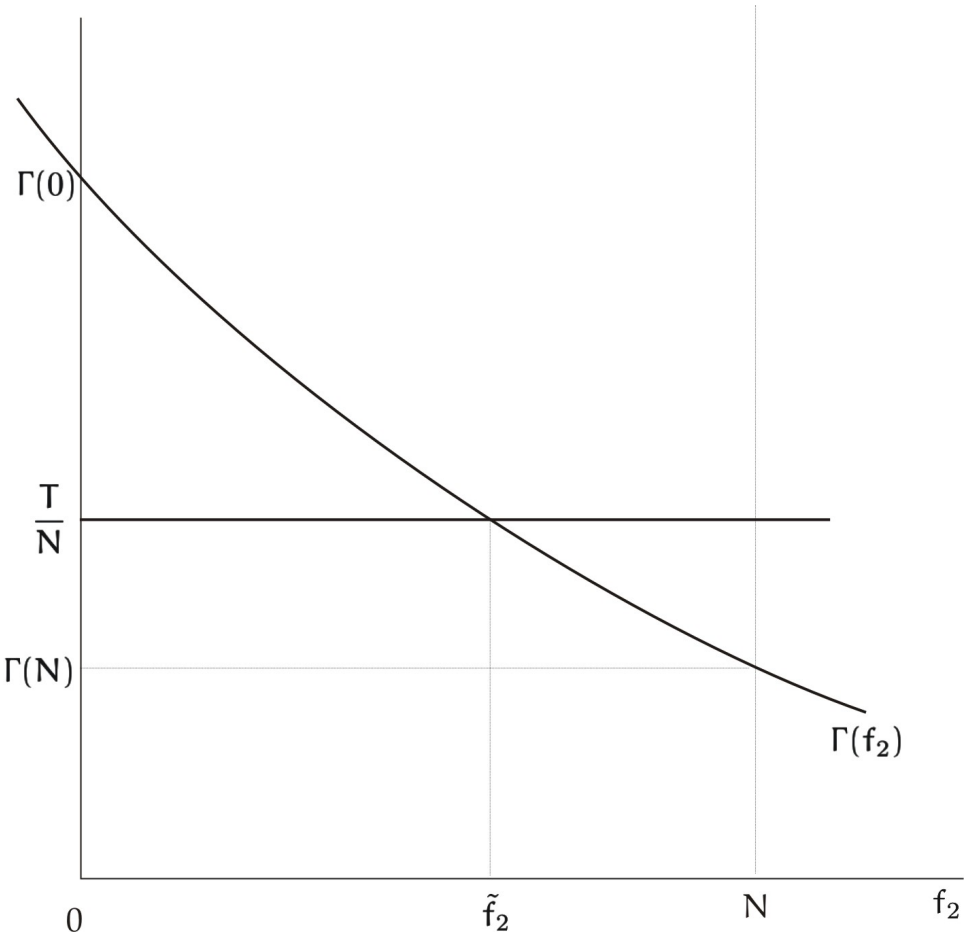

Figure 7

Table 1. TEXTILES AS A SHARE OF EXPORT (%)

	1965	1985
Hong Kong	**43**	**32**
India	36	18
Japan	17	3
Korea	**27**	**23**
Mauritius	**-**	**23**
Malaysia	-	3
Philippines	1	7
Singapore	6	4
Thailand	-	13

Source: ILO Yearbook of Labor Statistics.

Table 2. WOMEN AS A SHARE OF TOTAL EMPLOYMENT IN THE TEXTILE INDUSTRY (%)

	1981	1985	1990
Kenya	14	1	1
Mauritius	**82**	**75**	**67**
HongKong	**61**	**62**	**59**
India	8	8	-
Korea	**70**	**67**	**61**
Malaysia	-	8	7
Philippines	-	-	67
Singapore	81	84	82
Thailand	**-**	**80**	**73**

Source: ILO Yearbook of Labor Statistics.

Table 3. WOMEN AS A SHARE OF TOTAL EMPLOYMENT (%)

	1981	1985	1990
Kenya	18	20	22
Mauritius	27	32	35
Hong Kong	-	36	-
India	-	13	14
Indonesia	38	39	-
Japan	-	40	-
Korea	46	40	-
Philippines	34	36	36
Thailand	35	37	47

Source: ILO Yearbook of Labor Statistics.