

A strictly economic explanation of gender norms: The lasting legacy of the plough

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Abstract

We show that the descendants of primeval plough users may have an interest in maintaining the gender division of labour which was originally justified on comparative-advantage grounds, even though in a modern economy individual productivity depends on education rather than physical characteristics. The result rests on the argument that the contract enforcement institutions developed in response to the availability of the plough serve a purpose also in a modern economy because of a possible hold-up problem in the implementation of a Nash-bargaining equilibrium with domestic division of labour.

Key-words: Plough, comparative advantage, hold-up problem, migration.

JEL Codes: D03, J16, J61

1 Introduction

An influential article, Alesina et al. (2013), brings empirical evidence in support of the hypothesis advanced by Boserup (1970) that the gendered division of labour, whereby men tend to work outside the home in income raising activities, while women specialize in domestic, prevalently child raising activities, draws its origins from the introduction of the plough some four thousand years ago. Unlike shifting cultivation, which is very labour intensive but requires no special physical characteristics, plough cultivation is in fact less labour intensive but requires "upper body strength, grip strength, and bursts of power" which are more likely to be found in men. That gave the latter a comparative advantage over women in agricultural production. Astonishingly, Alesina, Giuliano and Nunn report that European and US residents descending from populations who introduced the plough such a long time ago in

their countries of origin display still today, in their country of destination, less equal gender attitudes than those descending from populations who did not experience that innovation. This raises the question, why is the legacy of the plough still felt after countless other innovations have drastically reduced the importance of physical characteristics, and the weight of the agricultural sector?

The often heard argument that women are genetically programmed to like raising children more than men do is irrelevant in the present context, because it should apply to everybody, not just to the descendants of ancient plough users. Another often heard argument is that men took advantage of the power achieved when physical strength mattered to create institutions that allowed them to continue indulging their taste for gender discrimination after the original comparative-advantage justification ceased to apply. The problem with this argument is that discrimination in general has an efficiency cost (Becker, 1957), and the cost of discriminating against women in particular increases as technological progress makes education, rather than physical characteristics, the main determinant of individual productivity. Even assuming that at least some men like discriminating against women, sooner or later the price they have to pay for this pleasure will become too high. Social norms also can be discriminatory. Boserup (1970) and Alesina et al. (2013) effectively argue that norms originating from the introduction of the plough survived their usefulness. But why? Should the principle that discrimination ceases when its efficiency-cost becomes sufficiently large not apply also to social norms?

The present paper offers an explanation that does not rely on men's taste for discriminating against women, nor on the assumption that, once established, a social norm remains such even if it is no longer efficient.

2 Modern economies

Parents and their children play a two-stage game. At stage 1, i 's parents give i a certain amount of money, b_i , and a certain amount of education, z_i . At stage 2, i 's wage rate will be $w_i = w^H$ with probability $\pi(z_i)$, and $w_i = w^L < w^H$ with probability $1 - \pi(z_i)$, where $\pi(\cdot)$ is increasing and concave, and $\pi(0) = 0$. If education is compulsory up to a certain level, z_i is measured from that minimum.

When w_i is revealed, i may choose to marry or stay single. If the latter, the utility function is

$$U_i = c_i,$$

where c_i denotes i 's consumption. If the former, the utility function is

$$U_i = c_i + ng,$$

where n denotes the number, and g the quality, of i 's children. Quality depends on the amount of money, y , and attention, a , that each child receives from i and her or his spouse jointly,

$$g = \ln y + \gamma \ln a, \quad \gamma > 0.$$

Notice that ng is a couple-specific public good as in Folbre (1994) and many other articles by a variety of other authors. Notice also that parents do not differentiate between sons and daughters.

Given that our focus is on the allocation of a between the couple, we treat the number of children born to them as a constant,

$$n = 2.$$

In large population, half the children born are boys, and the other half girls.

2.1 Stage 2

At this stage, i is endowed with one unit of time and b_i units of money, and commands a wage rate w_i . If i stays single, her or his maximized utility is

$$R_i = b_i + w_i.$$

If i marries, the couple thus formed Nash-bargain the allocation of their joint time and money endowments, and the distribution of their joint income. A spouse's reservation utility is her or his maximized utility as a single. We plausibly assume that men and women are matched by their reservation utilities. If several individuals of each sex have the same reservation utility, they are sorted into couples in such a way, that i 's utility is maximized given R_i . This makes sense, but we will see that it may not yield the first-best matching because of a possible hold-up problem.

Take the couple formed by a particular woman, f , and a particular man, m . Given that

$$R_f = R_m = R,$$

it follows that

$$w_m - w_f = b_f - b_m.$$

The Nash-bargaining (NB) equilibrium maximizes

$$N = (U_f - R)(U_m - R),$$

subject to f 's and m 's budget constraints,

$$c_f = b_f + (1 - 2\delta a)w_f - y + T$$

and

$$c_m = b_m + [1 - 2(1 - \delta)a]w_m - y - T,$$

where $0 \leq \delta \leq 1$ denotes f 's share of a , and T is defined as a transfer (positive, negative or zero) from m to f . Each parent is conventionally assigned the monetary cost of one child, but the amount effectively contributed will depend on the sign and size of T . Given that m 's and f 's attention are perfect substitutes in the production of g , the choice of δ will be either at a corner, or indeterminate.¹

For any given δ , the first-order conditions on the choice of a , y and T are, respectively,

$$\left(-2\delta w_f + 2\frac{\gamma}{a}\right)(U_m - R) + \left[-2(1 - \delta)w_m + 2\frac{\gamma}{a}\right](U_f - R) = 0, \quad (1)$$

$$\left(-1 + \frac{2}{y}\right)(U_m - R) + \left(-1 + \frac{2}{y}\right)(U_f - R) = 0 \quad (2)$$

and

$$(U_m - R) - (U_f - R) = 0. \quad (3)$$

The equilibrium value of y is

$$y = 2. \quad (4)$$

Those of a and T depend on the choice of δ .

For

$$w_f = w^L, \quad w_m = w^H,$$

the couple choose

$$\delta = 1, \quad a = \frac{2\gamma}{w^L}, \quad T = 2\gamma.$$

In this case, f does all the domestic work, and m all the market work. Therefore, he compensates her for the forgone earnings. Their common utility level is

$$U^*(R) := R - 2(1 + \gamma) + 2 \left(\ln 2 + \gamma \ln \frac{2\gamma}{w^L} \right).$$

In the opposite case, where

$$w_f = w^H, \quad w_m = w^L,$$

¹This is a simplifying assumption. If the mother's and the father's time contributions substituted at a diminishing marginal rate, the solution would be interior, and the specialization would be less than full, but this would make no difference of substance to the results.

the couple choose

$$\delta = 0, \quad a = \frac{2\gamma}{w^L}, \quad y = 2, \quad T = -2\gamma.$$

The only difference between this and the previous case is that, as m now does all the domestic work, and f all the market work, it is now her who compensates him for the loss of earnings. But the common utility level is still $U^*(R)$.

For

$$w_f = w_m = w, \quad w = w^H, w^L,$$

the couple are indifferent between splitting domestic and market work equally between them, or spinning a coin. Assuming the former,

$$\delta = \frac{1}{2}, \quad a = \frac{2\gamma}{w}, \quad y = 2, \quad T = 0$$

There is no compensation. If two low-wage person marry, the couple's common utility level is $U^*(R)$. But, if two high-wage persons marry, their common utility level is only

$$U^\circ(R) := R - 2(1 + \gamma) + 2 \left(\ln 2 + \gamma \ln \frac{2\gamma}{w^H} \right) < U^*(R)$$

because the opportunity-cost of the children is higher, and the equilibrium utility consequently lower than in the other cases for any given R .

Therefore, a marriage between two high-wage persons is inefficient. In an efficient matching, a high-wage person is always married to a low-wage person, because the latter is indifferent between marrying a high-wage or a low-wage person with the same R , but the former is better-off marrying a low-wage person with the same R . Realistically assuming that children are born at the start of stage 2, but wages are paid at the end (or at any rate in the course) of it, however, an NB equilibrium where the spouses have different wage rates may not be implementable. Given that once the children are born they cannot be sent back, and making the usual assumption that a legally enforceable pre-marital contract is out of the question because the transactions cost is prohibitively high for ordinary folks, the low-wage spouse will in fact demand to be paid at front. But, this payment will not be forthcoming if the high-wage spouse's money endowment is lower than the compensation due in the NB equilibrium, and credit is rationed. If that is the case, there is a hold-up problem. The low-wage person will consequently marry another low-wage person with the same R , and get the utility level $U^*(R)$. The high-wage one will have no choice but to marry another high-wage person with the same R , and get the utility level $U^\circ(R)$, which is not as good as $U^*(R)$, but still better than remaining single and getting only R .

2.2 Stage 1

At stage 1, i 's parents choose b_i and z_i , subject to

$$b_i + z_i = \bar{y}_i, \quad (5)$$

where \bar{y}_i , is the amount of money they have allotted to i (solving a problem analogous to the one that i and her or his partner will solve at stage 2), and to the further restriction that b_i must be large enough to enable i , at the next stage, to specialize in income raising activities by paying his or her spouse the equilibrium amount of compensation $T = 2\gamma$ at front if $w_i = w^H$,

$$\bar{y}_i - z_i \geq 2\gamma. \quad (6)$$

Given that w_i is still uncertain, and assuming risk aversion, the parents then maximize the expected value of $V(U(R_i))$, where $V(\cdot)$ is a concave function. That is the same as maximizing

$$EV(R_i) = \bar{y}_i - z_i + \pi(z_i) V(w^H) + [1 - \pi(z_i)] V(w^L) \quad (7)$$

subject to (6). If this constraint is not binding, the parents' optimization has an interior solution at $z_i = z^* \geq 0$, where z^* solves

$$\pi'(z_i) = \frac{1}{V(w^H) - V(w^L)}. \quad (8)$$

Otherwise, the solution is at the $z_i = 0$ corner.

Therefore, some children get an education (above the compulsory minimum), and some do not. If i does, his or her (maximized) expected utility is

$$EU^*(\bar{y}_i - z_i^* + w_i) = \pi(z_i^*) w^H + [1 - \pi(z_i^*)] w^L - z_i^* - 2\gamma + 2 \left(\ln 2 + \gamma \ln \frac{2\gamma}{w^L} \right).$$

Otherwise, i 's utility will be

$$U^\circ(\bar{y}_i + w^L) = w^L - 2\gamma + 2 \left(\ln 2 + \gamma \ln \frac{2\gamma}{w^H} \right) < EU^*(\bar{y}_i - z_i^* + w_i)$$

for certain.

3 From primitive to modern economies

In a primitive agrarian economy, a person's wage rate or physical productivity is independent of education. Parents may then give a child

money or other durables, but not an education,²

$$b_i = \bar{y}_i.$$

Continuing to assume that couples are matched as in the last section, all that was said then about the need to guarantee the actual delivery of T for an NB equilibrium with domestic division of labour to be implementable still applies. In the traditional societies that we normally associate with primitive economies, however, there is usually the possibility of a pre-marital contract, not between the betrothed, but between their families of origin.³ This contract may be enforced by legal means. More often, it is enforced – with the community’s tacit or overt approval – by extra-legal means ranging from ostracism to the threat or actual use of violence. An NB equilibrium with domestic division of labour can then be implemented even if (6) does not hold.

Let there be two such economies, A and B. For geographical reasons,⁴ the plough is used in country B, but not in country A. In A, the wage rate is equal to w^L for everybody, and domestic work is shared equally between the spouses ($\delta = \frac{1}{2}$). In B, a man’s wage rate is w^H thanks to the plough technology, but a woman’s wage rate is w^L . In this country, the wife does all the domestic work ($\delta = 1$) in order to release the husband’s time for agricultural production, but their families see to it, with community support, that the spouses get the same amount consumption.

Now suppose that i migrates from a primitive to a modern economy. In the destination country, given that i is uneducated, $w_i = w^L$. If i comes from country A, he or she will indifferently marry a native or an immigrant with the same R as her or himself, because her or his equilibrium utility will in any case be $U^*(R)$. If the spouse is a native with $w = w^H$ and $b \geq 2\gamma$, i will specialize in domestic work. The same applies if i is a woman from country A, and the spouse a man from country B. In all other cases, there will be no division of labour. All of this applies also to a woman coming from country B, but not to a man from that country. The latter can only marry another immigrant or a low-wage native, because no high-wage woman (which in this case would have to be a native) would marry a low-wage man *and* specialize in domestic work.

²That is another simplification. In reality, a small minority of prospective priests, scribes and astrologers will receive an education of sorts.

³This does not necessarily imply that the marriages are arranged by the two families, but that is typically the case.

⁴Using a wealth of archaeological and linguistic evidence, Diamond (2005) argues that the reason why agriculture and certain agricultural technologies developed in certain parts of the world rather than others, and spread in certain directions rather than others, is due to geographical factors.

What will happen to the immigrants' children? Observing that, in their new country, educated workers command a higher wage rate than uneducated ones, immigrants will consider the merits of investing in their children's education. If they originate from country A, they have no reason to treat their daughters differently from their sons. Not so if they originate from country B, however, because they then know that the enforcement institutions they brought over from their country of origin guarantee the implementation of an NB equilibrium where the woman specializes in domestic work, but not one where the man does. If i is a boy, his parents will then maximize (7), and choose $z_i = z_i^* \geq 0$. If i is a girl, however, they choose $z_i = 0$, in which case,

$$R_i = \bar{y}_i + w^L$$

for certain.

Of course, if their traditional contract enforcement institutions applied also when the high-wage spouse is the woman, parents originating from country B would have no reason to treat daughters differently from sons any more than parents originating from country A do. As it is, however, the interests of a girl's with country B ancestry are better served by a sum of money, than by an education. Are these institutions efficient? Given that $\pi(\cdot)$ is the same for everybody, in first best everybody would get the same amount of education irrespective of gender. In second best, however, the efficiency loss from educating only boys will be traded-off against the efficiency gain from relaxing (6).

Summing up, couples formed by natives or descendants of immigrants from country A tend to share domestic and market work equally between them. Only some of these couples – those in which the high-wage spouse satisfies (6) – will specialize, but this high-wage spouse could be the wife just as well as the husband. By contrast, the couples formed by descendants of immigrants from country B tend to practice their traditional gender division of labour, because their extra-legal contract enforcement institutions relax (6) if the high-wage spouse is the husband, but not if it is the wife. Only in some of these couples – those for whom the gain from relaxing (6) is not large enough to compensate for the efficiency loss from educating girls less than boys – husband and wife will share domestic and market work equally between them.

4 Discussion

Using a strictly economic argument, we have shown that men descended from ancient plough users may have an interest in maintaining the gender division of labour which was justified on comparative advantage grounds

in an agrarian economy, but not in a modern economy where productivity depends on education irrespective of gender. We have not assumed that employers derive utility from discriminating against women workers, or parents from giving daughters less education than sons. Nor have we assumed that men descended from ancient ploughmen somehow turned their initial comparative advantage into a permanent bargaining advantage. Most importantly, we have not assumed that a social norm, once established, remains such even changed circumstances make it inefficient. The reason for not assuming any of this is not that it is not true, but that it is neither necessary nor sufficient to explain the persistent legacy of the plough.

Our explanation is that, if people derive utility only from their own consumption, and from the quality and quantity of their children, in an efficient matching, both the husband and the wife have a low wage rate, or one has a high and the other a low wage rate. In the second type of couple, the high-wage spouse specializes in income raising activities, and the low-wage one in domestic, essentially child raising activities. For this specialized NB equilibrium to be implementable, however, either the high-wage spouse's money endowment must be large enough to compensate the low-wage spouse before the children are born, or there must be institutions that guarantee a later payment. Such institutions exist where the descendants of primeval plough users are concerned. Having developed in a context where that innovation gave men a comparative advantage over women in agricultural production, however, the guarantee applies only if the high-wage (or high-productivity) spouse is the man. When subsequent technological innovations make education rather than gender the source of comparative advantage, efficiency still requires that the high-wage spouse should specialize in income raising, and the low-wage spouse in child raising activities, but the former is not necessarily the man, and the latter not necessarily the woman. Given that the probability of getting a high wage rate conditional on education is the same for boys as for girls, all children should in fact get the same amount of education. Given the existing institutions, however, girls will get no education above any compulsory minimum, and the low-wage spouse in a different-wage couple will consequently be the woman. If those institutions persist, it must mean that the efficiency gain coming from specialization outweighs the efficiency loss from educating girls less than boys.

This argument does not need to be strengthened by bringing in additional assumptions. Indeed, it needs to be weakened because Alesina et al. (2013) do not find that the descendants of primeval plough users tend to practice a rigid gender division of labour, but only that their

gender attitudes tend to be less egalitarian than those of others. As already pointed out in footnote 1, the specialization would be less than full if the mother and the father's attention were not perfect substitutes in the production of child quality. Additionally, we must recognize that our utility function – of common use in microeconomics, especially in the economics of the family – is strictly appropriate only to an economy where survival and reproduction are the overwhelming consideration. In a prosperous economy, where essential consumption is assured and life expectancy high, people may be willing to pay a price for personal career satisfaction, or to spend time with their children. We can think of these forms of gratification as luxury goods. Even among the descendants of primeval plough users, a couple may thus take advantage of traditional contract enforcement institutions to specialize, but stop well short of total specialization in order to allow the woman to pursue a career, or the man to see more of his children.

5 References

Alesina, A., P. Giuliano and N. Nunn (2013), "On the origins of gender roles", *Quarterly Journal of Economics* 128, 469–530

Becker, G. S. (1957), *The Economics of Discrimination*, Chicago: The University of Chicago Press

Boserup, E. (1970), *Woman's Role in Economic Development*, London: George Allen and Unwin

Diamond, J. (2005), *Guns, Germs, and Steel: The Fates of Human Societies*, New York: W. W. Norton

Folbre, N. (1994), "Children as public goods," *American Economic Review* 84, 86-90