Global Circuits of Gender: Women and High-Tech Work in India and the U.S.

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Abstract

Can we benefit from looking in 'unlikely' places for alternative models of women's advancement in IT careers, especially through comparative methodologies? Will globalization undermine or exacerbate the hostile environments faced by women in engineering and technology careers? My research explores such issues through an intensive interview study of over 180 women and men IT personnel located in three globalized organizational settings: starting with a major Silicon Valley computer firm (AmCo), then following its subsidiary to India (TransCo), and comparing them to a local Indian IT firm in New Delhi (IndCo). I find that the IT industry has created new avenues of employment for women transnationally, but with variable trade-offs for women's high-tech careers. Surprisingly, the masculine 'cultures of engineering' often noted in the U.S. literature are weaker in my Indian cases. Women at IndCo face less questioning of their technical competence, and gain greater access to jobs like engineering. In the U.S. case, however, women technical workers are freed from the boundaries on their spacial mobility that are common in the Indian firms. The AmCo women are also much more likely to become IT managers and receive comparable wages to their male colleagues. I situate these dynamics in the contextual politics of information technology of Indian and the U.S. societies, and their contradictory interests in both drawing women into the IT workforce and excluding them from organizational power. Furthermore, I explore what happens in the global circuits between these sites by focusing on TransCo, the multinational subsidiary of AmCo located in New Delhi. Rather than exclusively adopting the gendered patterns of either the U.S. or Indian firms above, TransCo managers hybridize the two forms, which then makes gender discrimination more complex. Still, this also creates unique opportunities for women engineers and technical workers, as the 'hostile' IT environments of local contexts are destabilized, and women can propose alternative work relations.

The Context of Women in Engineering and IT

The literature tells us that IT workplaces can become hostile or even toxic environments for women (Frehill et al., 2007). Not only are they more male dominated in terms of numbers than other types of jobs, but they also tend be governed by "cultures of engineering" which involve male technical prowess as an organizing principle for social relations (Burris, 1993; Hacker,

1981; McIlwee and Robinson, 1992; Wajcman, 1991; Wajcman, 2004). The following project seeks to expand on this important theoretical field to address the implications these cultures of engineering in an increasingly global era.

Little attention has been directed, first of all, to the issue of whether there might be different kinds of discriminating environments across different national contexts. Scholars tend to take the notion of technical-skill based discrimination for women engineers as a given, when there are other models of gender hierarchy in IT workplaces operating around the world. This is also important because there are hidden advantages for women engineers in other settings like the Global South that may be useful in alleviating tensions in the Global North, and vice versa.

Second, there has been surprisingly little research on or attention to the global dynamics of IT workplaces, even though we're in a stage of rapid change, especially within the high tech industry. In this paper, I'll present the notion of "global circuits" as a focal point for viewing these processes (Ong, 1999; Peterson, 2003; Sassen, 1998; Sassen, 2000). I argue that global circuits have the potential to undo, as well as exacerbate, some of the problems that women have been facing in IT.

Diverging Trends in India and the United States

The cases of India and the U.S. illustrate many of the global dilemmas of women in technical work (Hafkin and Huyer, 2006). What they represent, first of all, is the difficulty of access for women in technical work and research. Even though these are such different countries in size, population, wealth, etc., both have relatively few women in these jobs.

The U.S.'s greater wealth and lower population do not help to pull women into technical work. Looking at the percentages of women in scientific and technical research around the world (Figure 1), we see that both India and the U.S. are the very bottom of the scale (UNESCO Institute for Statistics, 2006). While the world average (of about 90 countries) is at 34%, my two countries scrape the floor at no better than 10%. (See Figure 1)

What's distinctive is that these countries diverge in their long-term trends, and the direction that women's access to technical work is taking. The U.S. is on a clear downward trend, while India is moving upward.

We can see this first in enrollments in engineering degree programs. The U.S. has experienced a recent decline to about 17% in 2005; whereas India has been on a steady increase to 22% in 2000 (Committee of the Indian National Science Academy, 2004; National Science Foundation, 2007). (See Figures 2 and 3).

The same is true for IT jobs. Figures 4 and 5 present trends in the percent of women in the overall technical workforce (which includes high skilled jobs like technical and scientific research, but also the lower level jobs in data entry, communications, etc.). What we find is that from the early 1990s to the mid-2000s, the U.S. reveals a *decline* in women's access to IT jobs, dropping from 41% to 32%, whereas India experiences a sharp incline from 10% to 35% (Information Technology Association of America, 2005; NASSCOM, 2006). In fact, India has just surpassed the U.S. in women's IT workforce participation with a lead of 35%, 3% over the U.S.

The overall numbers of women in IT jobs may be tipping towards India as well. Statistics also show that India is producing more engineers than the U.S.—with some estimates as much as

300,000 in India versus 100,000 in the U.S. Indeed, some industry experts like the American Society of Engineering Education observe that there are more women engineers currently employed in India than in the U.S. (National Network of Education, 2007).

There are many theories and explanations of why women in India might have a better edge in high-tech work and research. Childhood socialization plays a part in this (Cohoon and Aspray, 2006; Fletcher, 1999). Scholarly studies have found that Indian pre-college students are much more confident about science and engineering and supportive of women than in the U.S. (Mukhopadhyay, 2005). A study of Indian study in four Indian cities found that girls are far less fearful of science and engineering subjects, that both boys and girls do not see science and engineering as "unfeminine," but instead expressive positive attitudes about it. Their families, moreover, support girls' entry into science and engineering for its earning potential, prestige for the family, and improving marriage-ability.

Other explanations for varying levels of women's presence in IT careers look at the workplace itself, and how organizational dynamics create barriers for women technical workers and researchers that men do not experience (Hacker, 1981; McIlwee and Robinson, 1992; Scott-Dixon, 2004; Woodfield, 2000). This latter approach is the one I take, as I'm interested in the barriers that are embedded in organizational practices, both written and unwritten, formalized and informal, in policy and in everyday practice.

Research Questions and Methodology

The methodology of the study involves case studies of three firms in India and the U.S., as well as intensive interviews with 180 workers, managers, and officials.

Two research questions will guide this analysis. First: Can we benefit from looking in "unlikely" places for alternative models of women's advancement in IT careers, especially through comparative methodologies? My curiosity, however, is if there might be different kinds of discriminating environments in different national contexts? Moreover, might there be hidden advantages in these settings that are hard to see when looking only at single firm or national context, but instead more visible when contrasting these settings side by side? Can we use those hidden advantages to our benefit?

What I find is that the IT industry has created new avenues of employment for women transnationally, but with variable trade-offs for women's high-tech careers. Surprisingly, the masculine "cultures of engineering" often noted in the U.S. literature are weaker in my Indian cases. Women face less questioning of their technical competence, and gain greater access to jobs like engineering. In the U.S. case, however, women technical workers are freed from the boundaries on their spatial mobility that are common in the Indian firms. These women are also much more likely to become IT managers and receive comparable wages to their male colleagues. I situate these dynamics in the contextual politics of information technology of Indian and the U.S. societies, and their contradictory interests in both drawing women into the IT workforce and excluding them from organizational power.

My second research question is: How will globalization affect this process? Will it undermine or exacerbate the discriminating environments faced by women in engineering and technology careers? I explore this by focusing on a multinational firm located in New Delhi. Rather than exclusively adopting the gendered patterns of either the U.S. or Indian firms above,

TransCo managers hybridize the two forms, which then makes gender discrimination more complex. Still, this also creates unique opportunities for women engineers and technical workers, as the "discriminating" IT environments of local contexts are destabilized, and women can propose alternative work relations.

My study represents women technical workers and researchers in private industry, in the field of computers and information technology (which may differ from academic and government settings). This analysis is based on case studies of three computer companies which share size, industry, and market characteristics, but with different locations and positions in the global economy.

The first is AmCo,1 an American company located in Silicon Valley, California. It is a founding company for the high-tech industry in Silicon Valley, and has subsidiaries all around the world. The second company, TransCo, is one of these subsidiaries which is situated in New Delhi, with its factory in Bangalore. Thus, it has American ownership, management, and policies, but it is entirely staffed by Indians (with few American expatriates). The third company, IndCo, is the Indian counterpart to AmCo. It is owned by Indians, and located in New Delhi. Like AmCo, it has been a leading high-tech company in its country (at the time of the study at least), and has subsidiaries worldwide, including California. All three companies have operations involving software development and hardware production, and all have similar gender ratios in their workforces—roughly 25-30% female.

Data collection occurred between 1995 and 1996, a time when the IT industry was taking off in profound ways in both India and the U.S. This was also a period when women were being recruited in these industries in substantial numbers for the first time.

My methodology involved original field work at each location. This included observation of work relations, document analysis of company human resource materials, and in-depth interviews with workers and managers. At each company, the principle investigator did field work at two units—the corporate office and a factory. Interviews were conducted either in English, or in Hindi with the assistance of an interpreter, and lasted 30 to 90 minutes. The total number of interviews at each site was 34 at AmCo, 60 at TransCo, and 51 at IndCo, with roughly half the interviews at the corporate office, and half at the factory in each company. Each sample was randomly selected, and balanced according to gender and occupational level.

My interest was in exploring the organization-wide dynamics that affect women in high-tech firms, so my research took me to many departments of the firms, from the top to the bottom: management, marketing, engineering, accounting, etc. at the corporate level, to circuit board manufacturing and computer assembly at the production level. In common, the majority of the workers in all locations are 30-40 years old, married, and with one or two children. In addition, the samples reveal a relatively high educational level. Even at the factory, most workers hold a high school diploma (at the lowest, 75%), and many of those hold a post-high school degree as well (37-50%). In the analysis below, I will highlight the experiences of women doing computer R&D (research and development) work in my study. However, I will attempt to show that broader dynamics of high tech firms affect many types of women technical workers in common ways.

Below I sketch profiles of the three firms and their climates towards technical women. I'll start with a comparison of AmCo and IndCo. These are two similar "local" IT firms, which

surprisingly represent very different types of discriminating environments for women in IT, and moreover, different types of hidden assets.

AmCo: Skill Discrimination in IT Work

Women technical workers at AmCo describe a type of "discriminating environment" that parallels studies of IT workplaces in the West. Much like the "culture of engineering," AmCo's gender hierarchies are organized around the core issue of technical skill. Technical competence is defined as a masculine trait, and alternatively, women are treated as second-class technical personnel, or even non-technical personnel. This skill-based division becomes the main barrier for women engineers and researchers, both in everyday interactions and in structural rewards.

In particular, it becomes problematic when women at AmCo when, during their course of their daily routines, they display or show themselves as technically-skilled. They report a number of disciplines from male colleagues and supervisors which discourage them from doing so. Sometimes colleagues will situationally enhance their status along expert / non expert lines (Burris, 1993). They may overemphasize the technical aspects of men's jobs and trivialize those of women's jobs. Or else, they may denigrate women's engineering skills. Randal, a quality check in the factory, explains how women engineers are weaker in intellectual ability because they are driven by emotion rather than logic:

> The men are more capable to do the engineering job, because engineering work is harder and it is more complicated. Men have the capability to make better decisions—not emotional ones. In engineering, you cannot go by emotion. It should be more by logic. Women make more emotional decisions, and that does affect the work. [A-30]

Colleagues may also sporadically *test women for their technical competence*—questioning women whether they really understand the minutia of their engineering jobs. This enforces an expectation of incompetence and sends women into self-doubt. Managers may also *"disappear" women's technical work*: ignoring women during technical meetings or even the products / outcomes of women's technical work (Fletcher, 1999). In a more extreme cases, women engineers at AmCo report that they are *mocked publicly for their technical knowledge* as a form of humiliation, especially by superiors.

There are tradeoffs for this system of gendered technical work at AmCo, however—especially when you compare it to its Indian counterpoint, IndCo. One is that there are more women in more women in management. While women are less respected for their technical skills, they are surprisingly given more freedom to display skills in leadership. Many of my informants, in fact, were plucked out of their engineering jobs to become IT managers. AmCo has also had two women CEOs, a rarity among Fortune 500 firms (which is still only at 9%) (Catalyst, 2003).

One employee explains: "It is true that the proportion of women in the management cadre is much higher than the proportion of women in engineering. As you move up the manager level—say at the Project Manager level—the ratio is 30-70, where 30 percent is female managers" [A-10]. By 2000, women at AmCo were 43% of mid-level managers, and 33% of senior managers, and 25% of the executive council members. This pattern is especially notable when comparing

across the other firms of my study. While my sample of interviewees at AmCo includes 40% women managers, IndCo's has only 31%, and TransCo's has 27%.

Another hidden asset is that AmCo women are also much more likely receive comparable wages to their male colleagues. While there's a gender gap in wages in all the firms of my study, the gap is smallest at AmCo, where there is a difference of only 14% in my sample between women's and men's wages, compared to 44% at IndCo. As I'll discuss below, an key source of these gains for women at AmCo is a strong set of gender equity policies, which are quite common in the American institutional and organizational context (Poster, Forthcoming).

IndCo: Spacial Discrimination in IT Work

Women IT workers at IndCo describe a very different kind of discriminating environment. It is a kind of discrimination not based on women's *skills* at technical workers, but on the *spaces* where they do their technical work. This model of male privilege in high tech work has nothing to do with denigrating or even questioning women's mental capability to do engineering or other technical work. Instead it focuses on questioning where, when and with whom women's technical is done.

While this may seem like a curious combination, the dynamic of space has been a well-noted tool of power and male authority in high-tech workplaces. For instance, the high tech industry in many parts of the work has achieved its dominance through regional geographic networks of research, business, and entrepreneurial IT actors (Saxenian, 1994). This industry has also thrived from the spacial formation of "high-tech parks," where scientific and technical researchers intensify their hypermasculine work culture through separations from the rest of the world, and moreover, accruing prestige on this basis (Massey, 1996; Massey et al., 1992).

In the case of IndCo, we see another kind of use of space. It involves the dividing of physical spaces inside high-tech firms as a way to manage the entry of women into high-tech work, and to maintain male control of resources inside the firm. The pretense is protecting women from dangerous environments, and limiting their movements to technical spaces that are non-threatening (an equally weak argument as that of women's lesser technical competence from AmCo). This creates barriers for women in that co-workers and managers at IndCo set up a variety of "boundaries" (Lamont and Molnar, 2002) on women's interactions and movements in the high-tech environment, both within and outside the firm.

These boundaries restrict women's daily routines, and their ability to do technical work and research in several ways. Some of the boundaries are *temporal*, meaning that women are not allowed to work at night, after regular business hours. Of course, some women don't mind this practice of being exempted from overtime, but it becomes problematic when they are left out of crucial research meetings that held with all the rest of the male members of the engineering team. Other boundaries are about women's *movements*, demarcating "male" spaces in the firm (be it offices, floors, rooms, etc.) where women are informally discouraged from going. This becomes problematic when women need to enter the offices of male colleagues for discussing their technical work, for instance. Boundaries on *mobility* outside the firm restrict women from making contacts with other engineers and researchers in universities, and from traveling outside the city and country to participate in global technical partnerships and forums which their male colleagues attend, and which are increasingly crucial for high tech work.

Yet underneath these barriers, there are hidden benefits for women technical workers at IndCo. Surprisingly, the masculine "cultures of engineering" often noted in the U.S. literature are *weaker* in my Indian cases. Women's technical skill is far more respected by staff and managers than in my U.S. firm. Throughout my interviews with IndCo employees, I found a common conviction that women and men have similar mental ability to do technical work. Women at IndCo face less doubting and testing of their technical competence. At the corporate office, a staff member says: "A woman is equally competent. What men can do women can also do, work-wise. What men can do, women can also do work wise. I don't think there should be any discrepancy."

Furthermore, while there are many jobs which are sex-typed at IndCo, engineering is not one of them: "For some of the jobs, you need different people. A lady may be good, and a man may not be. But not for all jobs. Like with electronics engineer, it's fine—both [women and men] can work." A factory operator also articulates this idea: "There are places where ladies should be—like in technical work ... In the interest of the company, the woman should work here." Many studies of gender in Indian high-tech firms have found similar sentiments (Chhachhi and Pittin, 1996; Parikh and Sukhatame, 2002).

This paradigm reflects not only a greater respect for women's abilities, it reveals something more profound—an assumption that *technical work itself has no gender*. This fundamental orientation towards women technical workers and IT work radically alters the climate of IT work in India. It facilitates women's entry and acceptance into highly technical jobs to a much greater degree than in the U.S. This marks another hidden asset for women at IndCo: greater access to jobs like engineering. A woman engineer explains: "Actually in IndCo, you will find quite a few females. The whole department must be having around 40%. In our group, most of the people are women—five out of eight. We are the communications group, the one which works for the communications software" (I-21). Engineering has larger concentrations of women than many other departments at IndCo, and moreover, far greater concentrations of women than AmCo, where women occupy at best 15% of the engineering jobs. Despite the celebrated location of this firm in the global high-tech landscape, AmCo has the lowest proportions of women in the jobs that are most closely related to technology.

TransCo: Global Circuits and the Hybrid Model of Gender in IT Work

The second research question of this analysis is about how globalization will affect this process: Will it undermine or exacerbate the discriminating environments faced by women in engineering and technology careers? For this, we turn to the third firm in the study, TransCo, which is owned by AmCo but located in New Delhi. It has U.S. policies, but completely Indian staff. The question is what happens when firms like this cross national borders? Should TransCo look more like AmCo or IndCo, or something else?

TransCo defied my expectations about what multinational firms typically do—it did not singularly impose or adopt either model of IT work, but instead hybridized them together. The medium for this process at TransCo is what I call "global circuits". This term refers to organizations and their components that cross national borders, whether physically or virtually. It can refer to a whole firm, as in the case of TransCo as a multinational subsidiary. Or else, it can refer to elements within these firms, like their employee policies, their managerial staff, their

technical personnel, and even their teams and work tasks—anything that can be transnationally mobile.

The key to understanding global circuits, however, is how they are freed from many of the traditional constraints of local IT settings, whether that is an everyday habit or long-standing point of view by managers about how to treat women in high-tech, or whether it is a set of formal governance systems which dictate employee practices for managers (e.g., from a corporate head office, from the state, etc.). Actors in global circuits, quite significantly, are in a liminal position where they are less bound by such ties—for both good and bad.

Indeed, this hybridization process at TransCo has the potential for transforming previous types of discriminating environments for women in IT, and creating new more egalitarian technical workplaces. However, it can also make new problems for women engineers and technical workers. Next, the discussion presents some examples of these global circuits, in transforming both the written policies and informal climates of women in technical work.

Innovations in Policy: Merging the Best of India and US for Women in IT

There are many good outcomes of the global circuits, which appear in TransCo's employee policies. Formal policies can pose significant barriers for women in IT firms, especially regarding work-family supports (Kelkar et al., 2002; Kelkar et al., 2005; Poster, 2005a; Poster and Prasad, 2005). One study of women in 75 IT firms found that the main policy complaints were about inflexible demands of the hours; insufficient support for flexible schedules and personal responsibilities; and incompatible career-building and family-building cycles (Catalyst, 2003). Indeed, these are all byproduct of the "engineering culture" with its "late night meetings, [and] extended travel as the norm" which "puts disproportional social pressure on women, especially mothers and single parents" (p. 11). IT firms in both the U.S. and India have begun to address these strains with very creative strategies, yet on two totally separate tracks.

TransCo, in an extraordinary step, and through its transnational position between these two settings, combines the best of these two policy tracks, and furthermore, customizes them for the needs of its own workforce.

From its American parent firm, for instance, TransCo adopts scheduling policies which alter timings to accommodate work to employees' family demands. In fact, TransCo claimed to be the first firm to institute "flextime" in India. Yet TransCo managers take it further to adjust to the needs of their workers. Because scheduled power outages are common in some urban areas of India like Mumbai (formerly Bombay), and alternating parts of the city will be without electricity and / or water for several days during the week, employees at TransCo were more interested in weekly forms of flexible scheduling (i.e., by day), rather than the sliding hours within a single day. What came out of this context was the concept of "alternative work options," which combines flextime with other more dramatic forms of job restructuring. It goes beyond the notion of adjusting arrival and departure times within the workday, to reconfigure broader weekly schedules.

From other Indian firms, however, TransCo borrows and integrates another set of policy traditions—the material benefits for families. Indian firms (similar to many in the European Union) are often known offer various kinds of concrete supports for workers' families in the form of direct payments, subsidies, and even some kinds of tangible objects for the household.

Therefore, like its Indian counterpart IndCo therefore, TransCo offers maternity benefits with three months paid leave, plus funds for delivery and birthing costs, and paid transportation to and from work. Furthermore, TransCo managers augment these material benefits, with a total package that includes over *seventy* items, including school tuition, kitchen items, and wages for servants to clean and cook at home. Managers were also in the process of developing an additional set of policies common to neither of the other two firms. An example is an adoption policy which would cover legal and medical expenses.

What results are work-family policies that are far more extensive and more innovative than in its parent firm back in the U.S., and even to those of comparable firms in India. This "hybrid" model arises out of a context where managers are in an unusual position to view first hand both Indian and U.S. work-family policy, and to have the authority to innovate their own policies. Indeed, while women workers at TransCo were critical of many aspects of the firm, work-family benefits was not one of them. They were generally impressed with and appreciative of the level of support for families, and found it vastly improved their concentration level and physical ability to do their IT work.

Innovations in the IT Climate: Removing Informal Barriers for Women

There is another kind of innovation for technical women that occurs at TransCo through the global circuits. This happens in the informal climate at TransCo, in the everyday practices of discriminating environments, as discussed earlier. Since the staff at TransCo is Indian, and the firm is also located in New Delhi, many employees expected to see the same system of barriers for women they had experienced in their previous jobs—the "space" model of gender in IT, as seen at IndCo.

Yet, TransCo global policies—imported from AmCo—prevent this from happening. In particular, two types of policies from AmCo play a role in this. First, there are a set of "fairness" policies, which focus on equal treatment for different kinds of workers gender, ethnicity, etc. Programs like gender equity and diversity inclusiveness are measures toward this end. Second, there are the "democratic relations" policies, which emphasize open communications and architecture, breaking down status hierarchies, and promoting a participatory, non-autocratic workplace.

Together these policies erase the visible kinds of markers of inequality in IT work environments—the kinds that are common in the space model of IT. In turn, this makes it much harder to justify the boundaries of women's activities in this scenario. An engineer explains: "Usually in Indian companies, men and women won't mix all together. They won't talk more than a "Hello" or "Hi." They will hesitate to talk. But it is not the case here. They mix well." Another echoes how it improves their cooperation in making the computer circuit boards: "For whatever reasons, normally in Indian companies men and women don't mix together. Men and women sit separately, on separate benches, tables. Here we'll work together. That happens more in multinational companies."

Many women at TransCo describe this dynamic as a new kind of "freedom", as does this field engineer: "AmCo policy is our founder's dream, and many people follow it. It is the most beautiful thing I have seen. And the environment is very friendly. It is quite different from the other Indian companies. It is quite different from the other multinationals. *It has a total*

freedom." Workers describe how they have a new freedom in their technical work and research—to interact and communicate with each other without the symbolic and physical gender boundaries.

In short, one of the hidden assets of the global circuit is its ability to displace a highly entrenched form of gender relations and assumptions about technical women. These features illustrate an undoing the discriminating climate for women in engineering and technical research. The absence of these boundaries makes technical research easier to do, and makes women more empowered. The irony is that AmCo has an extensive set of employee policies which are fairly useless at addressing its own "skill" based model of gender hierarchies in IT, but surprisingly effective at removing and blocking the "space" model.

Hazards: Implanting New Barriers for Women, Hybridizing IT Environments

The downside to the global circuit at TransCo is that new kinds of barriers for women in IT are introduced, implanted, and even combined. This is a process that has many stages. It starts with the AmCo policies, which have another outcome. They effectively push the space model to a new domain. Although the space model was removed from internal relations within the firm—when women are interacting and working with colleagues—it became stronger (and perhaps more hidden from view) in the external relations of the firm. This is the context when TransCo women are interacting with any of the various clients, customers, government officials, or other researchers in the outside environment.

In this external domain, women continue to experience the same notions of boundaries in IT work. Here's an example of how male employees at TransCo retain the space model in their practices of outside IT work for women:

> We have internal office jobs and then external world jobs, and I don't see any barriers to the other sex [women], that they will not be able to do these internal jobs. But with external jobs, from the organizational point of view, if I were the manager, I would prefer a man to handle that job. For example, I have to have somebody to go the customs house to clear commercial computer goods. If you have to go the customs area at the airport, and encounter the environment there, I certainly think that a woman would do it within her grit and determination, but just would not be efficient.

Meanwhile, something else happens. In the absence of the previous discriminating environment, a new one is introduced. Managers, who came from the U.S. to set up and run the firm, very subtly and even unconsciously carry with them the practices of the engineering culture. In turn, TransCo women began to feel the same kinds of barriers that their AmCo counterparts face: the questioning of their engineering skills, the trivializing of their technical aptitudes and accomplishments, the overlooking of their contributions to the software and hardware team projects.

This made one woman senior engineer, Shilpa, genuinely surprised. She encountered this new paradigm when her male colleagues expected her to do "documentation" than the real problem solving R&D work. Trying to figure out why this was happening, she confided in a colleague Tom, who recounts the conversation:

> She said: "Gee, do you think this is because I was not introduced properly into this account, or this environment, or this particular company—or just because I am a woman?" Shilpa has seen it [the engineering culture] from the other [woman's] side, and we have talked about how some male engineers will assume that the women engineers can [only] do things like the documentation, and that kind of stuff—not really getting in there, and figuring it out—created problems. And some of it *is* because they're women.

The overall impact of the global circuit is a hybrid model of gendered technical work. IT combines elements of both the skill and space based systems, applying one to women's work "inside" the firm, and the other to women's work "outside" the firm. As you can imagine, it can be very confusing to work in environments like this, where you are expected to behave one way inside the firm, and then another way outside. This part of the global circuit makes the discriminating environments of IT even more complex than we had considered them before.

Conclusions

This study has important implications for women doing technical research. In response to the initial research questions of this study, I would argue that both the U.S. and Indian settings have common features of their technical working environments which are discriminating to women, and characterized by hyper-masculine interpersonal relations.

Yet at the same time, there are hidden advantages to these varying models of women in IT. Sometimes you can't "see" them until you compare them to other settings, and for this reason, transnational methodologies provide us a unique glimpse into the process (Charles and Bradley, 2006; Mukhopadhyay, 2005; Poster, 2005b). By comparing my case studies, we see how IndCo is better for getting women into engineering and technical work and research, while AmCo is better at promoting women into IT management.

I explain these differences in terms of varying micro-organizational dynamics, but also in terms of varying broader socio-structural influences pulling women into high-tech work in each country. In India, the state has provided more educational institutions and structural access to help advance women into these jobs. As in indication of these benefits, women's wages in IT jobs are generally higher than in other similarly skilled professions. On the other hand, in the U.S. there is a stronger movement of women activists and professional organizations set up to ensure gender equity and hold firms accountable to their own written policies and public claims. This external network has helped to improve wage equity and promotions in AmCo (especially relative to IndCo).

Of course, this comparative perspective raises a number of intriguing questions about the tradeoffs of engineering and technical research for women. [2] Should Indian women act on the opportunities provided in IT—even if the gender gap in IT salaries (at firms like IndCo) is so high? Should women in the U.S. invest in the extensive IT training, perhaps banking on the greater chances of upward mobility into management—even if they are less likely than men to land a job in engineering (at firms like AmCo)? This study points to possible strategies for reducing such quandaries for women. By noting and borrowing successful organizational practices from other IT settings worldwide, we might take advantage of these hidden assets and

transform local IT institutions. Future research should address how we can harness these sometimes subtle practices which can be so instrumental for women engineers and technical researchers.

Second, global circuits have the potential to undo some of the problems that women have been facing in IT. The transnational firm in my study, TransCo, was able to undermine some of the localized barriers for women in IT and innovate new policies by integrating the best of work-family strategies in the U.S. and India. Yet, as my third finding reveals, global circuits have many dangers to look out for. Global circuits like multinational firms also provide an opportunity for managers to transplant new foreign work cultures, and to hybridize multiple kinds of barriers for women in IT. While this analysis represents only three case studies, it is my hope that future research explores the extent to which it is occurring on a more widespread basis.

Figures

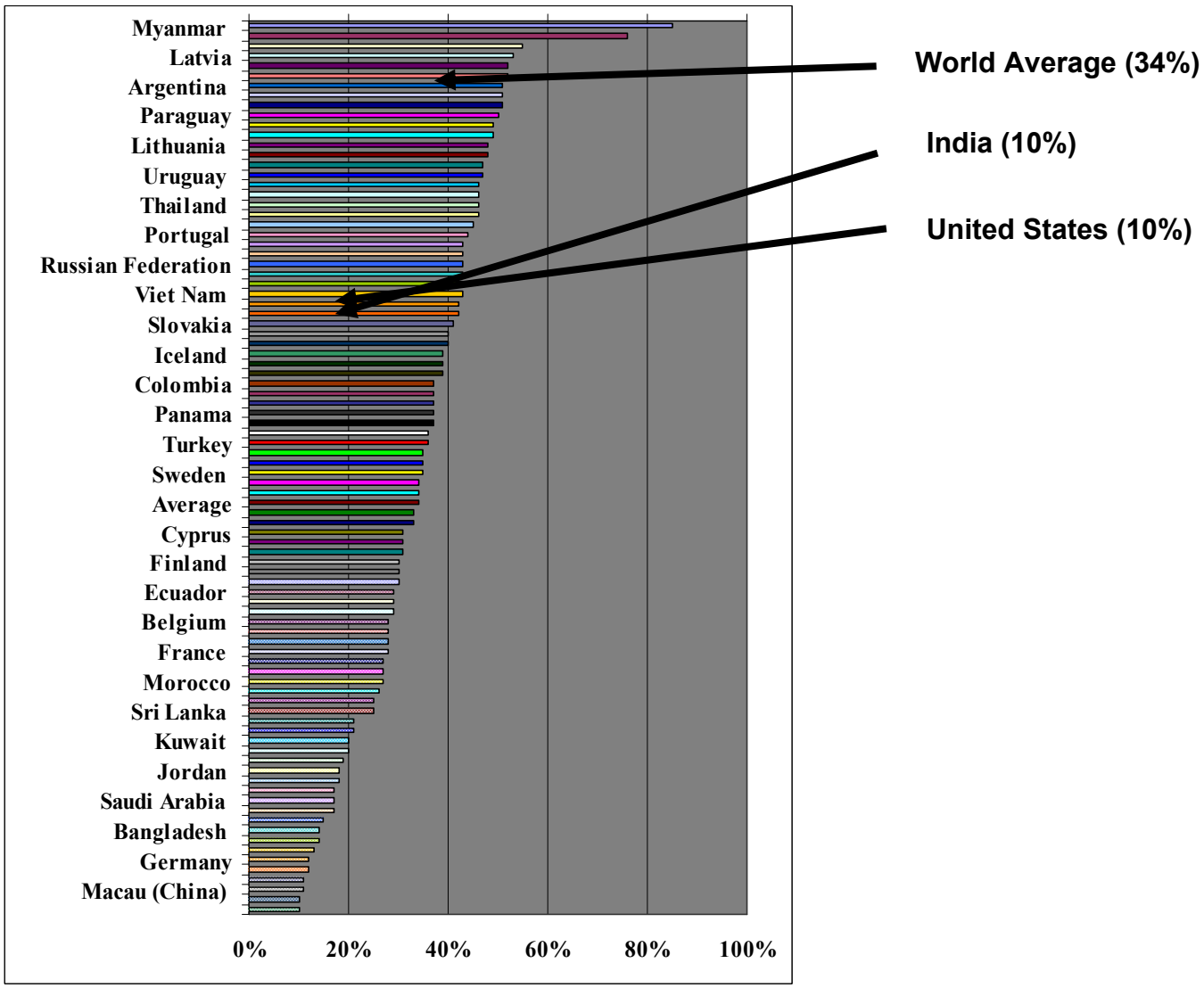
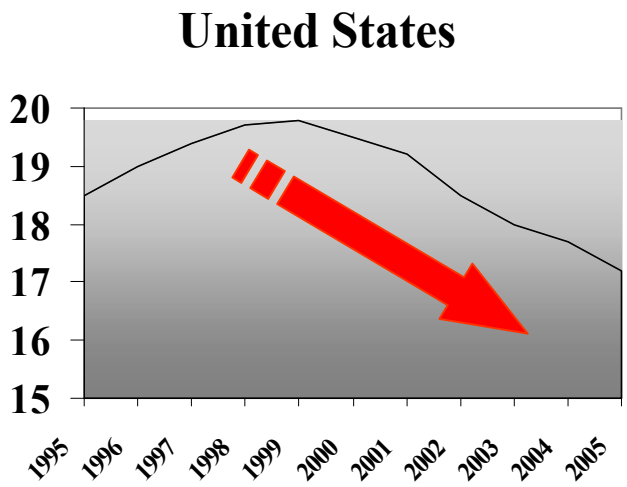
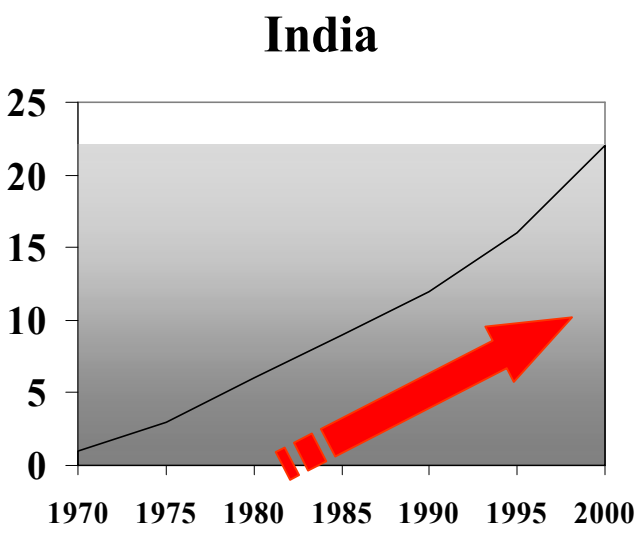


Figure 1. Percent Women in Scientific and Technical Research Globally, 2003

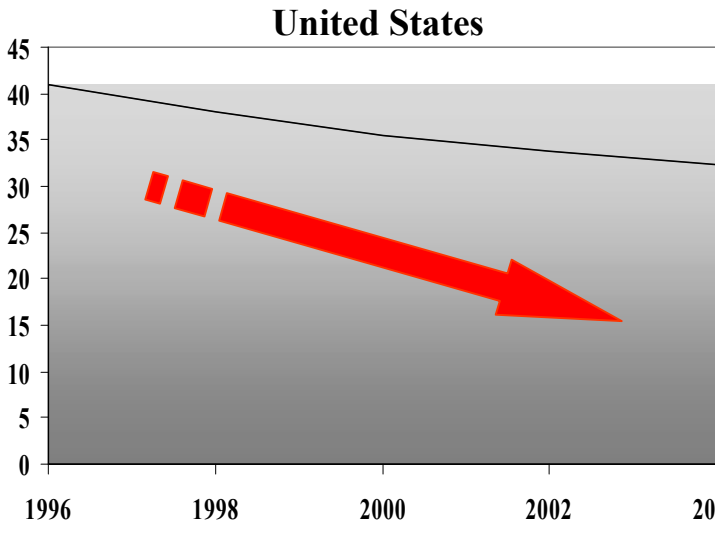
Source: UNESCO Institute for Statistics, 2006. Selected country labels only. Data for the U.S. is from Babco and Ellis, 2004.

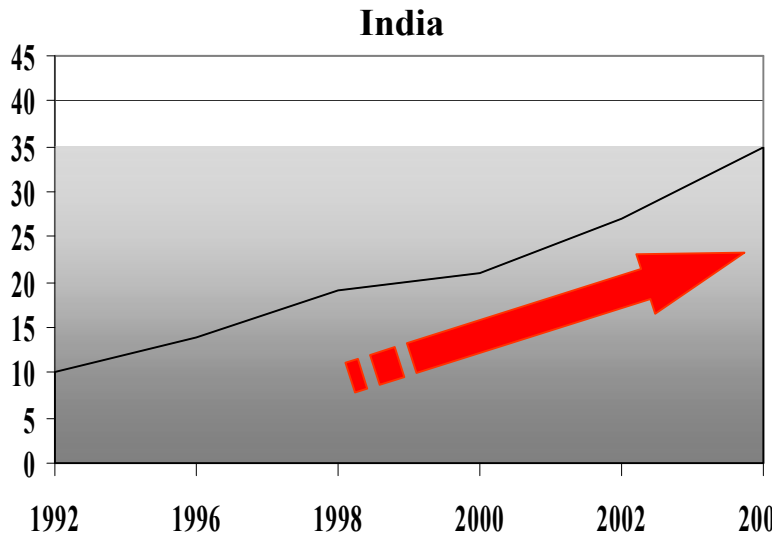




Figures 2 and 3. Percent Women Enrolled in College Engineering Programs

Sources: National Science Foundation, 2007; Committee of the Indian National Science Academy, 2004. Values for selected dates are estimated by the author based on broader trends.





Figures 4 and 5. Percent Women in the Information Technology Workforce

Sources: Information Technology Association of America, 2005; NASSCOM, 2006

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Bibliography

Babco, Eleanor and Richard Ellis. 2004. Women in Science and Technology: The Sisyphean Challenge of Change. Washington, DC: Commission on Professionals in Science and Technology, www.cpst.org.

Burris, Beverly H. 1993. Technocracy at Work. Albany, NY: SUNY Press. Catalyst. 2003.

Bit by Bit: Catalyst's Guide to Advancing Women in High Tech Companies. New York, NY: www.catalystwomen.org.

Charles, Maria and Karen Bradley. 2006. "A Matter of Degrees: Female Underrepresentation in Computer Science Programs Cross-Nationally." Pp. 183-204 in Women and Information Technology: Research on Underrepresentation, edited by J. M. Cohoon and W. Aspray. Cambridge, MA: MIT Press.

Chhachhi, Amrita and Renee Pittin. 1996. "Multiple Identities, Multiple Strategies." Pp. 93-130 in Confronting State, Capital and Patriarchy, edited by A. Chhachhi and R. Pittin. New York, NY: St. Martins Press.

Cohoon, J. McGrath and William Aspray, eds. 2006. Women and Information Technology. Cambridge, MA: MIT Press.

Committee of the Indian National Science Academy. 2004. Science Career for Indian Women, http://www.ias.ac.in/womeninscience. New Delhi, India: Indian National Science Academy.

Fletcher, Joyce K. 1999. Disappearing Acts: Gender, Power, and Relational Practice at Work. Cambridge, Ma: MIT Press.

Frehill, Lisa A., et al. 2007. "Women in Engineering: A Review of the 2006 Literature." SWE Magazine, www.swe.org 53(3):1-24.

Hacker, Sally L. 1981. "The Culture of Engineering: Woman, Workplace and Machine." Women's Studies International Quarterly (4):341-53.

Hafkin, Nancy and Sophia Huyer, eds. 2006. Cinderella or Cyberella? Empowering Women in the Knowledge Society. Bloomfield, CT: Kumarian Press.

Information Technology Association of America. 2005. Untapped Talent: Diversity, Competition, and America's High Tech Future. Arlington, VA: ITAA.

Kelkar, Govind, et al. 2002. "IT Industry and Women's Agency: Explorations in Bangalore and Delhi, India." Gender, Technology and Development 6(1):63-84.

Kelkar, Govind, et al. 2005. "Women's Agency and the IT Industry in India." Pp. 110-131 in Gender and the Digital Economy: Perspectives from the Developing World, edited by C. Ng and S. Mitter. New Delhi, India: Sage.

Lamont, Michele and Virag Molnar. 2002. "The Study of Boundaries in the Social Sciences." Annual Review of Sociology 28:167-195.

Massey, Doreen. 1996. "Masculinity, Dualisms, and High Technology." Pp. 109-125 in Bodyspace, edited by N. Duncan. London: Routledge.

Massey, Doreen, et al. 1992. High-Tech Fantasies. London, UK: Routledge.

McIlwee, Judith and J. Gregg Robinson. 1992. Women in Engineering: Gender, Power, and Workplace Culture. Albany: State University of New York Press.
Mukhopadhyay, Carol. 2005. "The Scientific Gender Gap Should Be Considered Comparatively." Anthropology News March:4.
NASSCOM. 2006. "Knowledge Professionals Fact Sheet." www.nasscom.in (Retrieved 7/15/06):1-5.
National Network of Education. 2007. "More Engineering Students in India than in the US." www.indiaedunews.net (June 8):1.
National Science Foundation. 2007. Women, Minorities, and Persons with Disabilities in Science and Engineering, www.nsf.gov/statistics/wmpd. Arlington, VA: Division of Science Resource Statistics.
Ong, Aihwa. 1999. Flexible Citizenship: The Cultural Logics of Transnationality. Durham, NC: Duke University Press.
Parikh, P.P. and S.P. Sukhatame. 2002. Women in the Engineering Profession in India: The Millenium Scenario. Bombay, India: Indian Institute of Technology.
Peterson, V. Spike. 2003. A Critical Rewriting of Global Political Economy: Integrating Reproductive, Productive, and Virtual Economies. London, UK: Routledge.
Poster, Winifred R. 2005a. "Organizational Change, Globalization, and Work-Family Programs: Case Studies from India and the United States." in Work-Family Interface in
International Perspective, edited by S. A. Y. Poelmans. Mahwah, NJ: LEA Press.
Poster, Winifred R. 2005b. "Three Reasons For a Transnational Perspective on Work-Family Policy." Pp. 375-400 in Work and Life Integration: Organizational, Cultural, and Individual Perspectives, edited by E. E. Kossek and S. J. Lambert. Mahwah, NJ: LEA Press.
Poster, Winifred R. Forthcoming. "Filtering 'Diversity': A Global Corporation Struggles with Race, Class, and Gender in Employment Policy." American Behavioral Scientist.
Poster, Winifred R. and Srirupa Prasad. 2005. "Work-Family Relations in Transnational Perspective: Case Studies from India and the United States." Social Problems 52(1):(net yet assigned).
Sassen, Saskia. 1998. Globalization and Its Discontents. New York: The New Press.
Sassen, Saskia. 2000. "Women's Burden: Counter-Geographies and the Feminization of Survival." Journal of International Affairs 53(2):503-524.
Saxenian, AnnaLee. 1994. Regional Advantage: Culture and Competition in Silicon Valley and Route 128. Cambridge: Harvard University Press.
Scott-Dixon, Krista. 2004. Doing IT: Women Working in Information Technology. Toronto, Canada: Sumach Press.
UNESCO Institute for Statistics. 2006. "Women in Science: Under-Represented and Under-Measured." Bulletin on Science and Technology Statistics 3(November):1-7.
Wajcman, Judy. 1991. Feminism Confronts Technology. University Park, PA: Pennsylvania State University Press.
Wajcman, Judy. 2004. TechnoFeminism. Malden, MA: Polity Press.
Woodfield, R. 2000. Women, Work, and Computing. Cambridge, UK: Cambridge University Press.

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Notes

1. Company names in this study have been changed to preserve employee anonymity.
2. I thank Judy Wajcman for helpful comments. Sole responsibility for content lies with me.