Gendered Employment and Public Spending in China

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Abstract

This paper econometrically analyzes the relationship between public spending and gendered urban employment in China for the period 1999-2009. Proponents of gender-sensitive public policies suggest that spending on healthcare and education may increase long-run growth and women's relative employment via the expansion of paid care work (increasing labor demand) and reductions in unpaid labor (increasing labor supply). Female, male, and gender-relative employment growth are estimated as functions of public spending while controlling for demand, structural change and capabilities. Economic growth and human capital are also included in a simultaneous equation estimation. While healthcare results are mixed, education spending is positively associated with economic growth, employment growth for both genders, and women's relative employment. Using economic significance calculations, we describe how well-directed public policies can promote both long-and short-run benefits in gender equality and economic growth.

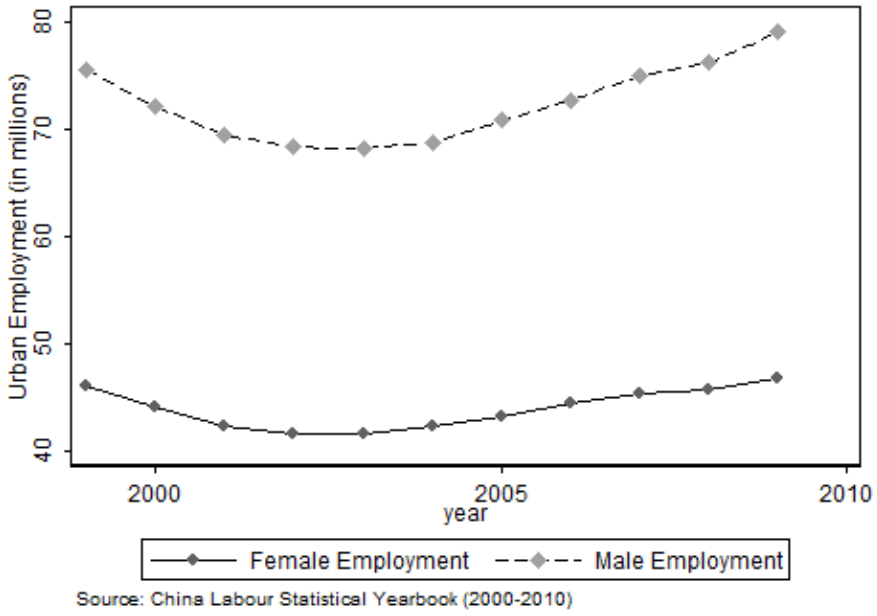

Figure 1: Annual Gendered Employment in China (1999 to 2009)

1 Introduction

In the mid-to-late 1990s women in the People's Republic of China (hereafter China) appeared perfectly positioned to experience significant gains in their relative livelihoods; China's high growth was accompanied by one of the world's highest rates of female labor force participation (Maurer-Fazio, Hughes, and Zhang, 2005). Instead, however, Chinese scholars urged urban women to voluntarily leave paid labor and return to the home to make room for men in the workplace (Liu, 2007). Many factors could have influenced this apparent preference for male labor: reform-induced structural change, increased industrialization, the evolving role of the state, dynamic trading patterns, or the reemergence of a cultural ideology. As these cultural and structural shifts, all consequences of the economic reforms implemented to transition the economy from socialism to a market economy, may affect women's and men's welfare differently (Ding, Dong, and Li, 2009), uncovering their distinct relationships with gendered employment would provide valuable information to policy makers. Empirical studies which have attempted to uncover the relationship between gender equality and this transition lead to conflicting results when considering the reforms in their entirety (Maurer-Fazio, Rawski, and Zhang, 1997; Meng, 1998). This is not surprising given the complexity inherent in such a vast undertaking. By separating out a component of the reforms, a specific element of public spending, we hope to provide an unambiguous analysis of its relationship with gender equality to discover what role public spending may have played in the lack of significant advancement in women's relative welfare from 1999 to 2009, and what role it can play in the future.

One of the main objectives of the economic reforms implemented from 1996 to the present was to increase privatization of state-owned enterprises. Such privatization resulted in declines in urban employment for both genders during the first seven years of its implementation, with women experiencing larger relative declines than men (Ding

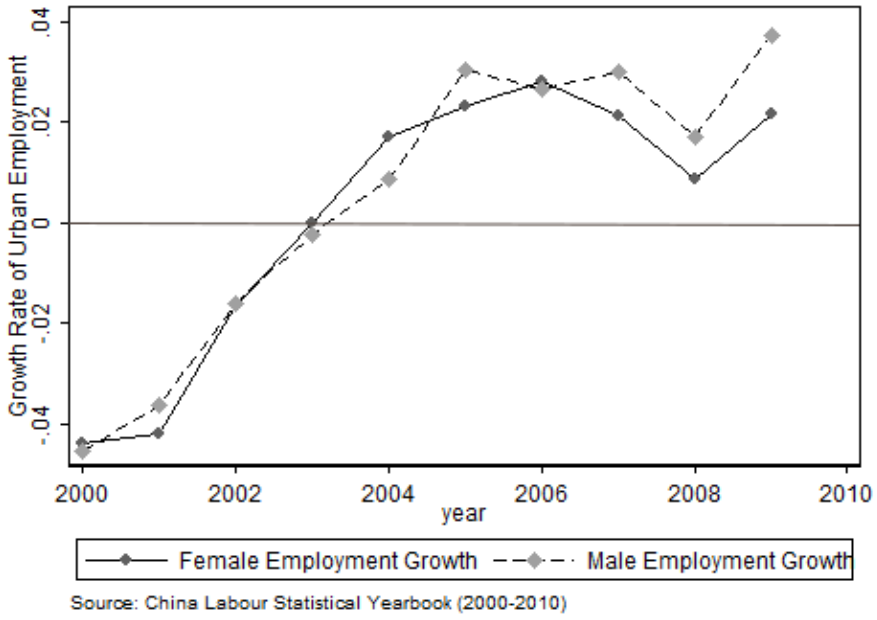

Figure 2: Annual Gendered Employment growth (2000 to 2009)

et al., 2009). Figure 1 illustrates gendered employment patterns for the rest of this reform period (2000 to 2009), where we find declining employment through 2004. As the restructuring of state-owned enterprises (SOEs) eased and public spending increased, urban employment began to recover for both genders (Figure 1). However, during the recovery period the growth rate of men's employment was often greater than women's (Figure 2), indicating that during this time women's employment actually fell relative to men's.[1]

In this work, we endeavor to determine what role public spending on social infrastructure, that is, spending on education and healthcare, plays in the processes of economic growth and gendered employment creation/destruction by answering the following questions: 1) Are the categories of social infrastructure spending positively associated with women's employment growth to a greater extent than men's? 2) Is either category positively related to employment growth for both genders? 3) Is either category positively correlated with economic growth? With these questions, we aim to test the possibility of a "win-win" situation as proposed by Seguino, Berik, and van der Meulen Rodgers (2009) who argue that infrastructure spending may present an avenue in which policy makers can reach development goals while also increasing gender equality. Controlling for demand, structural change, and human capabilities, we estimate gendered employment growth as a function of social infrastructure spending using multiple econometric techniques including ordinary least squares, instrumental variable, generalized method of moments, and three-stage least squares to estimate a system of simultaneous equations. We also include economic significance calculations and discuss the policy implications of the results in which we offer a new perspective on the relationships between gendered employment, social infrastructure spending, structural change, and economic growth in

[1]Significant differences in growth rates exist in six of the ten years presented in Figure 2; in five of those six observations men's employment growth is greater than women's.

China during the latter portion of the economic transition.

Given the recent literature advocating for gender-sensitivity in public policy decisions and the unique state control over the allocation of public spending in China, this paper provides an original, timely analysis of Chinese public policy and its effects on gendered employment and economic growth. Our results indicate that spending on education appears to satisfy the "win-win" criteria, being positively associated with employment growth for both genders, women's relative employment, and economic growth. Thus, education spending may be used as a policy lever to achieve development goals in a gender-sensitive manner. These results, applicable to many developing countries, provide key insights into the potential ramifications of public policies on gendered employment and economic growth in both the short and long-run.

Our study contributes to the literature in a variety of ways. First, we focus on social infrastructure spending while most similar studies focus on physical infrastructure. Second, we control for structural change, a variable often ignored in employment estimations. Third, given the difficulty of locating reliable, consistent, and gendered data on the Chinese economy, our unique study details our data sources and descriptions and therefore may help others locate data for future work on the role of gender in the Chinese labor market. Fourth, we add policy guidelines to the literature which can aid in the decision-making process of those in power, particularly in developing countries.

The remainder of the paper is organized as follows. In section two we present a critical review of the literature relating public spending and gendered employment and include a discussion of the potential labor demand and supply effects of infrastructure spending. In section three we outline our theoretical model, while in section four we describe the data and our econometric tests. We provide our results in section five and include estimations of economic significance in section six. We include a discussion of the policy implications of the results in section seven and conclude the paper in section eight.

2 Literature

In order to understand the relationship between social infrastructure spending and gendered employment, it is critical to first identify the two theoretical avenues through which the public sector can influence women's relative employment in the developing world: labor supply and labor demand.

On the supply side, social infrastructure spending influences women's unpaid labor burden via access to healthcare and education, which help to determine their time requirements in the home, and therefore the time that can be allocated to paid labor. With healthcare, reductions in public spending often manifest as decreased funding for clinics and immunizations, thus increasing the time required to care for the sick in the home (Elson, 1995). Such tasks, which are often allocated to women, reduce their ability to participate in paid labor.[2] Through a similar chain of causality, women's access to funding for education reduces their unpaid labor burden, increasing their ability to participate in paid labor, their bargaining power within the household, and gender equality

[2]Another result of this reduction in health care is the negative impact on school enrollment for girls. Often the first taken out of school to care for ailing family members, girls' future labor supply and relative wages fall with reductions in healthcare spending (Elson, 1995).

(Braunstein, 2008).[3]

On the demand side, Razavi, Arza, Braunstein, Goulding, and Cook (2012) underline the importance of the public sector in employment creation for women through two channels: first, women constitute a relatively large portion of public sector employment, and second, relative to men, a larger portion of women's total employment is concentrated in the public sector. Thus, in general, increased public spending which results in public sector employment may benefit women's labor demand to a greater extent than men's. Additionally, there are specific avenues through which public spending can increase women's relative employment opportunities. Spending on health and education, termed "care" sectors, can influence women's relative labor demand as these sectors act as employment engines particularly for women (Razavi, Arza, Braunstein, Goulding, and Cook, 2012). Often considered women's domain, healthcare and education involve the reproduction of the labor force and are therefore more positively associated with women's labor demand than men's (Braunstein, van Staveren, and Tavani, 2011). Therefore, spending on social infrastructure may increase women's relative labor demand in addition to their labor supply.[4]

Boschini (2003) argues that education spending can have other effects on women's labor in the future as well, given that cuts in education spending lead to decreasing rates of human capital attainment, particularly among girls. Monetary constraints can lead to selection distortion effects in which families are forced to choose to educate only those with the highest expected returns, often male children, thus constraining future employment opportunities and wages for girls. Wang and Cai (2008) argue that this chain of causality is especially true in China as evidenced by the general preference for educational investment in boys. It follows that when reductions in education spending result in human capital distortions, women's relative labor market opportunities and outcomes are depressed.[5]

Having identified the theoretical avenues, we next discuss the empirical results of public sector spending on women's relative employment. In a China-specific analysis of the relationship between aggregate public sector spending and gendered employment, Ding, Dong, and Li (2009) evaluate urban married women's employment in eleven provinces from 1988 to 2002 and find that the decreased role of the state led to greater declines in women's employment than men's, demonstrating a potential gender bias in Chinese public sector employment. Little has been published with regards to the gendered impacts of spending specific to social infrastructure. Seguino, Berik, and van der Meulen Rodgers (2009) provide the only consideration of this relationship and using the case of Trinidad and Tobago, present an example of how reductions in spending on health increase women's

[3]This chain of causality may be particularly relevant in the case of Chinese migrant workers who are often forced to leave urban areas when denied access to education and childcare. Urban governments have been known to use education as a tool to decrease the flow of migrants from the rural areas by denying education to migrant children and closing schools not officially sanctioned by the government in order to reduce the supply of migrant labor in urban sectors (Jacobs, 2011).

[4]This differs from physical infrastructure spending which involves employment in heavy, male-dominated industries such as construction, resulting in greater relative labor demand for men (Seguino and Were, 2013).

[5]Additionally, the resulting gender inequality in education can significantly impact the economy via lower levels of economic growth in the long-run (Boschini, 2003; Dollar and Gatti, 1999; Klasen and Lamanna, 2009).

relative unpaid labor burden, negatively impacting their relative labor supply. The lack of additional empirical work on this relationship leads us to discuss the literature relating physical infrastructure (broadly defined as spending on water, sanitation, transportation, and electricity) and gendered employment. Since physical infrastructure spending theoretically influences women's relative time allocations on related activities such as water collection, and thus their time allocated to paid labor (labor supply), this relationship is similar to that of social infrastructure on the supply-side (Agénor and Canuto, 2012; Seguino, Berik, and van der Meulen Rodgers, 2009).

Fontana and Natali (2008) evaluate the relationship between public spending on physical infrastructure and gendered time allocation on related activities in Tanzania. They find that increasing physical infrastructure spending raises productivity and household standards of living while also reducing unpaid labor burdens; this shift in time allocations is associated with an increase in women's labor supply and gender equality in employment. Similarly, Wamboye and Seguino (2012) empirically analyze the gendered effects of public spending in Sub-Saharan Africa and find that physical infrastructure spending reduces women's unpaid labor burdens, increases their access to education and human capital, and decreases maternal mortality, all of which positively influence women's labor force participation and economic growth. In analyzing declining physical infrastructure, Agénor and Canuto (2012) find such policies increase women's unpaid labor burdens and reduce economic growth in developing countries.

Though this literature focuses on gender equality in employment, the implications on long-term equality in well-being are implied. While stimulating employment may not be a sufficient condition for increasing gender equality, it is a necessary one; women's participation in the labor force, income streams, and presence in society/political processes are all steps towards gender equality. This perspective is reflected throughout the intra-household bargaining literature in which outcomes such as labor supply, well-being, and the distribution of household goods are determined by the relative capacity (including constraints such as time, wages, and priorities) and voice (the ability to make decisions, and express priorities within the household) of each household member (Braunstein, 2008). An empirical estimation of the effects of public spending on gendered employment creation is the first step in analyzing its impact on gender equality.[6] Given our focus on public spending in "care" sectors, which provide women with more employment opportunities in the public sphere, increasing employment may directly increase gender equality since compensation for public employment is often superior to that of the private-sector (Razavi, Arza, Braunstein, Goulding, and Cook, 2012).

It is important in this section to also recognize the duality of the macroeconomy and gender equality, where gendered variables influence the macroeconomy while the macroeconomy also influences gendered outcomes. This work begins with Klasen and Lamanna (2009) who find gender equality in employment and human capital positively related to economic growth. Evaluating the same path, Braunstein (2012) and Doss (2013) argue that women's income and educational attainment are positively associated with productivity (and thus, economic growth) via their impacts on spending on children's

[6]Bauer, Feng, Riley, and Xiaohua (1992), argue that due to the significant occupational segregation in the Chinese labor market, in which women are prevented from horizontal and vertical movement and from obtaining positions in sectors with higher pay, providing women opportunities in the paid labor market will not necessitate an increase in their well-being.

health and education at the household level. These authors evaluate the path from gender equality to the macroeconomy, a path which has now become fairly well established in the literature. Few empirical studies, however, have focused on the reverse path where the macroeconomy influences gendered outcomes. Due to the dual nature of this relationship, our study aims to contribute empirical results that complement these previous studies and provide avenues in which a virtuous cycle of gender equality and economic growth can be achieved.

3 Theoretical Approach

In this section, we build the functional form used to estimate gendered employment as a function of public investments in social infrastructure while controlling for demand, structural change, and individual capabilities. We next discuss each control beginning with demand and individual capabilities. Given the endogeneity of economic growth and human capital accumulation in estimating employment (where they are both determinants of employment and determined themselves by many of the same variables as employment), we include functions for growth and human capital. Lastly, we provide the motivation for incorporating structural change into our estimations before comparing our model to that of the literature.

First, as our area of interest is social infrastructure spending, our employment function begins with public spending on education and healthcare. Next, we control for the employment effects of demand by including the growth rate of GPP per capita in addition to the specific categories of production, including investment disaggregated by funding source, public spending and trade.[7] Structural change is proxied with the level of industrialization while individual capabilities include population growth and human capital accumulation. Our equation for estimating employment, Emp_{pt}, is

(3.1)
$$\begin{aligned} Emp_{pt} = \beta_p + \beta_1 Health_{p,t-1} + \beta_2 Educ_{p,t-1} + \beta_3 Gr_{p,t-1} + \beta_4 FInv_{p,t-1} + \beta_5 DInv_{p,t-1} \\ + \beta_6 G_{p,t-1} + \beta_7 Trade_{p,t-1} + \beta_8 Pop_{p,t-1} + \beta_9 HC_{p,t-1} + \beta_{10} Ind_{p,t-1} + \epsilon^1_{pt} \end{aligned}$$

where $Health$ and $Educ$ are public spending on health and education as percentages of GPP, respectively, Gr is the growth rate of real gross provincial production (GPP) per capita, $FInv$ and $DInv$ are foreign and domestic investments, respectively, as percentages of GPP, G is public spending less spending on social infrastructure as a share of GPP, $Trade$ is the sum of exports and imports as a share of GPP, Pop is the growth rate of population, HC is gendered human capital attainment of at least the secondary level, Ind is industrial output as a percentage of GPP, ϵ^1_{pt} are typical disturbance terms, β_p are time-invariant provincial fixed-effects, and β terms are unknown parameters we wish to estimate, for all provinces, p, in time, t. Employment is estimated with lagged values of all independent variables under the assumption that they take time to effectively stimulate

[7] We disaggregate demand in order to identify the possible differing gendered effects of each component which contrasts with an otherwise similar formulation of employment by Seguino and Were (2013) who aggregate demand with their usage of real GDP per capita to control for demand in levels. We also include trade, the sum of exports and imports, in our analysis as opposed to exports alone.

employment growth. Each dependent variable is estimated with its associated gendered human capital variable.

This equation is used to estimate three separate dependent variables: the growth rates of urban female and urban male employment and equality in employment. Our proxy for gender equality in employment, henceforth "the gap," is estimated such that

$$Emp^{gap} = \frac{Employment^f}{Population^f} - \frac{Employment^m}{Population^m}$$

where positive correlations with the gap imply increases in gender equality measured in employment opportunities, and vice versa (Seguino and Were, 2013).

Next, we discuss each control beginning with demand. Per capita growth, an endogenous variable in our employment formulation, is a function of the elements of production including the level of output, population, human and physical capital, the relative size of the public sector, and trade which represents the level of interaction with foreign markets. Thus, our equation for the growth rate of real GPP per capita, Gr, is

(3.2)
$$\begin{aligned} Gr_{pt} = {} & \eta_p + \eta_1 FInv_{p,t-1} + \eta_2 DInv_{p,t-1} + \eta_3 Trade_{p,t-1} + \eta_4 Pop_{p,t-1} + \eta_5 HC_{p,t-1} \\ & + \eta_6 GPPpc_{p,t=0} + \eta_7 Health_{p,t-1} + \eta_8 Educ_{p,t-1} + \eta_9 Sci_{p,t-1} + \eta_{10} Trans_{p,t-1} \\ & + \eta_{11} Proj_{p,t-1} + \eta_{12} Admin_{p,t-1} + \epsilon^g_{pt} \end{aligned}$$

where HC is the ratio of female-to-male human capital, $GPPpc_{t=0}$ is the natural log of GPP per capita in 1999, Sci, $Trans$, $Proj$, and $Admin$ are public spending on science, transportation, community projects, and administration as percentages of GPP respectively, η_p are time-invariant provincial fixed effects, ϵ^g_{pt} are disturbance terms with usual properties, and η terms are unknown parameters.[8] All independent variables are lagged one period under the assumption that these determinants take time to effectively stimulate growth.

In controlling for individual capabilities, and thus human capital accumulation, it is necessary to account for inherent endogeneity in our estimation of employment. Therefore, following Mankiw, Romer, and Weil (1992), the growth rate of gendered human capital, gHC, is modeled as a function of the current stock of, and net investment in, human capital such that

(3.3)
$$gHC_{pt} = \alpha_p + \alpha_1 HC_{pt} + \alpha_2 Educ_{p,t-1} + \epsilon^{hc}_{pt}$$

where α_p are provincial fixed-effects, ϵ^{hc}_{pt} are typical disturbance terms, and α terms are unknown parameters we wish to estimate. This model is used to estimate all three dependent variables of human capital accumulation: the growth rates of female and male human capital as well as the ratio of female-to-male human capital.

Lastly, we control for the effects of structural change on gendered employment by utilizing industrialization—that is, the shift of resources and production from the rural, labor-intensive agricultural sector to the urban, capital-intensive manufacturing sector—as its proxy. Throughout the literature macroeconomic shocks, such as industrialization

[8]This formulation is similar to that of Gramlich (1994), who analyzes the impact of public infrastructure on output in the US. It is also consistent with the Chinese growth literature (Zhang and Zou, 1998; Lin and Song, 2002; Wei and Hao, 2010).

and trade and investment liberalization, are found to affect the labor market outcomes of men and women differently (Humphries, 1988; Berik and van der Meulen Rodgers, 2008). Given the extent of gendered employment segregation in China, where men (women) are more prominent in industries which may expand (contract) with industrialization, women's employment may be disproportionately harmed by the process of industrialization (Liu, 2007; Seguino and Were, 2013). Additionally, since industrialization includes a re-allocation of labor demand from rural to urban sectors, our proxy for structural change also captures gendered migration patterns.[9]

Our employment model is similar to that of Braunstein and Grown (2011) in which taxation, state control variables, and fixed effects determine state-level gendered employment in the US. We incorporate similar control variables, though we additionally include measurements of trade and capital. While these additional controls may not be appropriate for a US state-level analysis, they are appropriate for a provincial-level analysis of the Chinese economy.[10] The main difference between the models is our focus on revenue collection and public spending, respectively. In this format, our model tests the hypothesized positive effects of public spending on gendered employment, net of the anticipated negative tax effects. Our model is also similar to the recent study by Seguino and Were (2013) who analyze the effects of physical infrastructure on the gap in Sub-Saharan Africa. Using similar control variables, our work additionally includes separate estimations of gendered employment growth for each gender.

4 Data

Our panel data, originating from three National Bureau of Statistics of China (NBS) publications, namely, *China Statistical Yearbook* (CSY), *China Labour Statistical Yearbook* (CLSY), and *China Population and Employment Statistics Yearbook* (CPESY), includes data from all 31 Chinese provinces for the period 1999 to 2009 (see Appendix B for detailed descriptions and sources).

Gender disaggregated employment is defined as the number of individuals employed—those physically present and actively working either part or full-time—at year's end in urban units (CLSY). This includes foreign and domestic workers with either urban household registration, or rural household registration who have been employed in their urban unit for a time period exceeding six months at year's end. The reporting agency for CLSY, the Labor Ministry, provides the most narrow definition of 'urban,' restricting the definition to cities only. Alternatively, NBS, the reporting agency for CSY, defines

[9]The urban household registration system, known domestically as *hukou*, discourages individuals with rural household registration from obtaining employment in many urban sectors through fines and additional taxes on businesses who hire such individuals, or the withholding of services to workers who migrate (Fan, 2003; Sicular, Ximing, Gustafsson, and Shi, 2007; Jacobs, 2011). Despite these restrictions, migration appears significant as evidenced by an increase in the flow of 'permanent' rural-to-urban migrants (workers with rural household registration who have maintained employment in the urban sector for longer than 6 months) from 80 million in 2001 to 137 million in 2007 (National Bureau of Statistics of China, State Statistical Bureau, 2010c), the majority of whom are male (Fan, 2003).

[10]Mean Gross capital formation as a percentage of GDP in China during the time period of our analysis (1999 to 2009) is almost 40% and has been steadily increasing (National Bureau of Statistics of China, State Statistical Bureau, 2010c), while in the US it averages just over 18% and has been steadily declining (The World Bank, 2010).

'urban' as including both cities and larger township and village enterprises (National Bureau of Statistics of China, State Statistical Bureau, 2010c).[11] The term 'employed' also adds complexity to this analysis; the definition changed in the NBS publication of 1999 data when 'not-on-post' workers—laid off individuals who were still associated with their urban employment unit despite not actively working at year's end—became excluded from the definition of employed.[12]

Table 1: Descriptive Statistics

	Mean	Standard Deviation
Growth	11.7%	7.7%
Population	39.4 million	25.1 million
F-to-M population	96.3%	3.3%
Urban population	19.0 million	14.1 million
F-to-M urban population	95.5%	2.5%
Public spending as % of GPP	8.2%	6.7%
Science as % of GPP	0.2%	0.1%
Transportation as % of GPP	0.4%	1.0%
Community projects as % of GPP	0.6%	0.8%
Administration as % of GPP	4.6%	4.6%
Health as % of GPP	0.8%	0.6%
Education as % of GPP	2.6%	1.2%
Foreign investment as % of GPP	1.5%	1.3%
Domestic investment as % of GPP	22.7%	10.8%
Trade as % of GPP	29.0%	38.2%
Industrialization as % of GPP	87.3%	39.5%
Female employment	1.42 million	0.88 million
Female HC as % of employees	19.2%	12.1%
Male employment	2.33 million	1.31 million
Male HC as % of employees	22.9%	10.1%
F-to-M human capital	80.0%	15.7%
F-to-M employment	59.5%	7.1%
Gap	-11.9%	7.8%

Notes: Means and standard deviations calculated as annual averages from 1999 to 2009, and across all 31 provinces. Public spending (including aggregate and disaggregated spending categories), fixed assets, trade, and industry measured in billions of Yuan. Source: Employment data from author's calculations based on data from *China Labour Statistical Yearbook* (2000-2010); others from author's calculations based on data from *China Statistical Yearbook* (2000-2010).

[11] See Bauer, Feng, Riley, and Xiaohua (1992) and Ghose (2005) for further discussions of the many differing definitions of 'urban' in the reporting of Chinese data.

[12] See Banister (2005) and Maurer-Fazio, Rawski, and Zhang (1999) for a discussion of the different definitions of employment provided by the NBS and the Labor Ministry. While it is possible to sum the figures of employment in urban units and not-on-post workers to obtain a consistent employment estimation for years prior and post 1999, data for not-on-post employment in urban units is not disaggregated by gender.

Referring to the descriptive statistics in Table 1, mean female employment in urban units is approximately 1.4 million employees, just over half of the mean male employment in urban units estimated at 2.3 million, such that the ratio of female-to-male employment is 0.60. With a mean of -11.9%, the gap indicates that urban male employment as a ratio of the urban male population is about 11.9% higher than that of the ratio of urban female employment to the urban female population.

Using CPI data (reported by NBS, as is all future data unless otherwise specified), we create a provincial CPI index and deflate all monetary variables to 1999 yuan. GPP data is calculated using the income approach at current prices while economic growth is calculated as the growth rate of real GPP with a mean of 11.7% per year. In the aggregate, provincial-level public spending, net of spending on social infrastructure, is calculated as the sum of public expenditures on science, transportation, finance, security, social welfare, community projects, government administration, and agriculture with a mean of 8.2% of GPP. Education and health expenditures account for approximately 2.6% and 0.8% of GPP, respectively. These public expenditures include spending from local, provincial, and central sources and are not specific to a certain ownership type.[13]

Trade, calculated as the sum of exports and imports, has a mean of 29.0% of GPP. Fixed assets, a flow variable which captures the volume of construction activities and purchases of equipment, materials, and technology that adds to its current stock, is commonly used throughout the Chinese growth literature as a proxy for investments (Chen and Fleisher, 1996; Lin and Liu, 2000). Braunstein (2006) and Braunstein and Brenner (2007) find that foreign investment exhibits gender-specific employment effects, providing the motivation for separating fixed assets by funding sources (foreign-and domestically-funded) with means of 1.5% and 22.7% of GPP, respectively.[14] Industrialization, our proxy for structural change, is measured as industrial output as a proportion of GPP with a mean of 87.3%. Human capital, measured as the completion of at least secondary-level formal education, is disaggregated by gender with means of 19.2% and 22.9% for female and male employees, respectively. Provincial-level population, including both rural and urban residents, has a mean of approximately 39 million people per province, while the mean of urban population only is estimated at about 19 million.

4.1 Econometric Tests

Due to the nature of panel data, we employ the Levin-Lin-Chu panel unit root test (Levin, Lin, and James Chu, 2002) which utilizes a pooled Dickey-Fuller t-statistic under the null hypothesis of nonstationarity (Bornhorst and Baum, 2006). We reject the null for the gap, population, trade, human capital, and growth but cannot reject the null for the remaining variables. After first differencing the nonstationary variables and applying

[13]The 'Brief Introduction' to Section 8 (Government Finance) of National Bureau of Statistics of China, State Statistical Bureau (2010) details the data collection techniques of the Ministry of Finance, the reporting unit for public expenditure data.

[14]Braunstein (2006) finds a positive relationship between foreign-direct investment and women's employment in semi-industrialized countries, such as China. In a subsequent article, Braunstein and Brenner (2007) find that when skill requirements increase in the sectors funded by foreign investments, women employed in these sectors are often replaced by men; in 1995, FDI was positively associated with employment and wages such that women experienced relatively larger gains than men, however by 2002, this pattern had reversed as FDI shifted to sectors with higher productivity.

the Levin-Lin-Chu test once more, we are able to reject the null for all the previously nonstationary variables. All further estimations include first-differenced variables for all the initially nonstationary variables as well as population.

Next, we execute Hausman tests on all three models as panel data tests for overidentifying restrictions with null hypotheses of consistency between the random and fixed-effects estimators. We find sufficient evidence to reject the null where the random-effect estimator is biased in the estimation of the gap. We therefore estimate the gap with the unbiased ordinary least squares (OLS) estimator only. There is not sufficient evidence in either of the growth estimations to reject the null. However, since there is adequate reason to believe the fixed-effects estimator may be appropriate, we present OLS regressions with both fixed and random-effects in the estimations of both female and male employment growth.[15]

Following Greene (1997), we calculate a modified Wald statistic for group-wise heteroskedasticity for each model and find that we are able to reject the null of homoskedasticity at the 5% significance level in all three cases. Using the Pesaran cross-sectional dependence test with a null of non-correlated residuals, we find evidence to reject the null at the 5% significance level for all three estimations, and conclude that our estimations exhibit cross-sectional dependence across provinces (De Hoyos and Sarafidis, 2006). To compensate for both heteroskedasticity and cross-sectional dependence, we provide panel-corrected standard errors in our estimations.

To detect multicollinearity, we produce correlation matrices which can be found in Appendix C. We find trade positively correlated with initial GPP, and female and male human capital with correlation coefficients of 0.81, 0.74, and 0.76, respectively. Public spending is somewhat correlated with health expenditure with a correlation coefficient of 0.66. Other administrative expenses are correlated with spending on transportation, health, and community projects, with correlation coefficients 0.76, 0.70, and 0.65, respectively, while spending on transportation and health are correlated with a coefficient of 0.75. Absolute values of all other correlation coefficients are less than 0.60. According to Kennedy (2003), two variables should be considered collinear if the absolute value of their correlation coefficient is greater than 0.80 or 0.90. Therefore, the relationships between trade and initial GPP and human capital for both genders may cast doubt on the validity of their coefficient estimates given that only the variation unique to that variable is used to estimate their coefficients. Thus, given the anticipated high variance of these estimations, results related to these partially correlated variables should be viewed with caution.

Due to the possible endogeneity of economic growth in our employment estimations, we use provincial land area and inflation as instruments for economic growth in our 2SLS-IV and generalized method of moments (GMM) techniques. We calculate the Cragg-Donald Wald F statistics to test for weak instruments and find that our statistics exceed the Stock and Yogo (2005) critical values, indicating that our instruments are satisfactorily strong. Additionally, utilizing a Sargan-Hansen test of overidentifying re-

[15]The fixed-effects estimator provides coefficient estimates under the assumption that the dependent variable is partially determined by time-invariant effects—in our case, provincial-level fixed-effects where each province has a unique, time-invariant intercept—whereas the alternative estimator (random-effects) provides estimations under the assumption that the cross-province variations are random and uncorrelated with the independent variables.

strictions with a null hypothesis of instrument validity, we are unable to reject the null at the 5% significance level in our female and male employment estimations, signifying that these regressions are not over-identified. However, the null is rejected in the estimation of the gap, implying that this regression may be over-identified and the results from our 2SLS estimation of the gap should be viewed with appropriate caution.

Lastly, following Drukker (2003) and Wooldridge (2001), we test for serial correlation of our panel data with a null of no serial correlation. Using a Wald test of this hypothesis, we do not find evidence to reject the null and conclude that there does not exist significant serial correlation in any of the three estimations.

5 Results

In addition to estimating gendered employment, growth, and human capital accumulation (equations 3.1, 3.2, and 3.3) simultaneously, via a three-stage least squares estimation, as it is the most appropriate estimator for our model, we regress gendered employment using OLS, 2SLS-IV, and GMM estimators which provide robustness to the results.[16] Tables 2, 3, and 4, present our OLS, 2SLS-IV, and GMM results with dependent variables of the gap, female employment growth, and male employment growth, respectively.

Table 5 presents the results from our simultaneous equation estimation. We briefly cover the results in this section before discussing their significance and implications in greater detail in the next section. Given the formulation of the gap, positive coefficients imply greater gender equality, and vice-versa. Several important results emerge from this estimation including positive and statistically significant relationships between the gap and economic growth, and public spending and educational expenditure as shares of GPP in multiple estimations (Tables 2 and 5). Statistically significant negative relationships emerge between the gap and domestically-funded fixed assets, spending on health, and industrial output as percentages of GPP in several estimations. It is imperative to specify here that a movement toward gender equality in employment (an increase in the gap) is only desirable if it occurs via a rise in women's employment (upward harmonization), while strictly avoiding reductions in male employment (downward harmonization). Therefore, we chose to estimate the growth rates of female and male employment separately in order to test each variables' affect on the growth rate of employment.

As Tables 3 and 5 illustrate, economic growth, trade, health and education expenditure are positively correlated with female employment growth at statistically significant levels across all specifications. The single exception is the relationship between female employment growth and health expenditure in the GMM estimation; while the coefficient is positive, it is not statistically significant. We also find both domestically-funded fixed assets and industrialization positively correlated with female employment growth at statistically significant levels in at least one estimation.

The growth rate of male employment is positively correlated with economic growth and public spending on education, trade, and industrial output as percentages of GPP across all specifications (Tables 4 and 5). Additionally, in several estimations, domestically-funded fixed assets and public spending on health as proportions of GPP are positively related to growth rate of male employment at statistically significant levels.

[16] Results for the simultaneous estimation of human capital accumulation are available upon request.

Table 2: Gap estimations: OLS, 2SLS-IV, and GMM

Dep Var: $Gap = \frac{Employment^f}{Population^f} - \frac{Employment^m}{Population^m}$	(1) OLS - FE	(2) 2SLS - IV	(3) GMM
Growth	0.056	0.075	-0.013
	(0.028)**	(0.057)	(0.027)
Foreign investments as % of GPP	0.178	0.167	0.190
	(0.180)	(0.194)	(0.208)
Domestic investments as % of GPP	-0.079	-0.077	0.017
	(0.063)	(0.041)*	(0.024)
Public spending as % of GPP	0.171	0.167	0.147
	(0.168)	(0.063)***	(0.032)***
Population growth	0.007	0.030	-0.016
	(0.055)	(0.065)	(0.038)
Female-to-Male HC	0.017	0.017	-0.001
	(0.025)	(0.018)	(0.004)
Health as % of GPP	-1.906	-1.634	-3.260
	(1.832)	(1.052)	(0.468)**
Education as % of GPP	1.583	1.751	1.018
	(0.826)*	(1.218)	(0.468)**
Trade as % of GPP	0.014	0.014	0.001
	(0.013)	(0.018)	(0.001)
Industry as % of GPP	-0.011	-0.007	-0.036
	(0.020)	(0.020)	(0.011)***
Lagged F-to-M employment growth			0.946
			(0.008)***
R2	0.950	0.950	0.950
Observations	279	279	279

Notes: All independent variables are lagged one period. Standard errors in parentheses; * significance at 10%; ** significance at 5%; *** significance at 1%. Foreign and domestic investments, public spending, health, education, and industry are all first differenced. Growth is instrumented by provincial land area and inflation in the 2SLS and the GMM estimations.

Table 3: Female Employment Growth estimations: OLS, 2SLS-IV, and GMM

Dep Var: Female employment growth	(1) OLS - FE	(2) OLS - RE	(3) 2SLS - IV	(4) GMM
Growth	0.227	0.242	0.354	0.195
	(0.056)***	(0.063)***	(0.074)***	(0.102)*
Foreign investments as % of GPP	0.210	0.433	0.132	0.422
	(0.432)	(0.468)	(0.299)	(0.349)
Domestic investments as % of GPP	0.178	-0.038	0.189	0.033
	(0.009)*	(0.118)	(0.108)*	(0.089)
Public spending as % of GPP	0.074	0.025	0.047	-0.143
	(0.130)	(0.143)	(0.100)	(0.113)
Population growth	-0.083	-0.045	0.075	-0.007
	(0.096)	(0.106)	(0.095)	(0.112)
Female HC	0.002	-0.001	0.002	0.000
	(0.001)*	(0.000)	(0.001)*	(0.000)
Health as % of GPP	3.609	5.171	5.527	4.367
	(1.966)*	(1.991)***	(1.977)***	(2.677)
Education as % of GPP	2.799	3.269	3.976	3.422
	(0.856)***	(0.983)***	(0.961)***	(1.089)***
Trade as % of GPP	0.095	0.056	0.098	0.035
	(0.027)***	(0.008)***	(0.031)***	(0.009)***
Industry as % of GPP	0.038	0.079	0.067	0.019
	(0.040)	(0.043)*	(0.047)	(0.031)
Lagged female employment growth				0.408
				(0.119)***
R^2	0.50	0.29	0.48	0.40
Observations	279	279	279	279

Notes: All independent variables are lagged one period. Standard errors in parentheses; * significance at 10%; ** significance at 5%; *** significance at 1%. Foreign and domestic investments, public spending, health, education, and industry are all first differenced. Growth is instrumented by provincial land area and inflation in the 2SLS and the GMM estimations.

Table 4: Male Employment Growth estimations: OLS, 2SLS-IV, and GMM

Dep Var: Male employment growth	(1) OLS - FE	(2) OLS - RE	(3) 2SLS - IV	(4) GMM
Growth	0.204	0.178	0.290	0.090
	(0.062)***	(0.062)***	(0.076)***	(0.087)***
Foreign investments as % of GPP	-0.534	-0.226	-0.593	-0.363
	(0.253)**	(0.309)	(0.372)	(0.374)
Domestic investments as % of GPP	0.205	-0.018	0.213	0.055
	(0.073)***	(0.096)	(0.077)***	(0.045)
Public spending as % of GPP	-0.001	-0.060	-0.019	-0.207
	(0.134)	(0.149)	(0.078)	(0.104)**
Population growth	-0.053	-0.093	0.054	-0.108
	(0.103)	(0.101)	(0.095)	(0.105)
Male HC	0.002	-0.001	0.002	0.000
	(0.001)**	(0.000)***	(0.001)***	(0.000)*
Health as % of GPP	2.407	3.447	3.724	1.969
	(2.116)	(2.096)	(1.842)**	(2.326)
Education as % of GPP	1.829	1.884	2.638	1.914
	(0.810)**	(0.838)**	(0.800)***	(0.926)**
Trade as % of GPP	0.099	0.048	0.099	0.020
	(0.019)***	(0.008)***	(0.037)***	(0.006)***
Industry as % of GPP	0.119	0.154	0.139	0.076
	(0.040)***	(0.043)***	(0.039)***	(0.035)**
Lagged male employment growth				0.427
				(0.094)***
R2	0.52	0.30	0.52	0.47
Observations	279	279	279	279

Notes: All independent variables are lagged one period. Standard errors in parentheses; * significance at 10%; ** significance at 5%; *** significance at 1%. Foreign and domestic investments, public spending, health, education, and industry are all first differenced. Growth is instrumented by provincial land area and inflation in the 2SLS and the GMM estimations.

Table 5: Simultaneous Equation Estimation

	Female employment growth	Male employment growth	Gap	Economic Growth
Growth	0.236	0.210	0.060	
	(0.046)***	(0.041)***	(0.024)**	
Foreign investments as % of GPP	0.265	-0.564	0.176	1.694
	(0.367)	(0.321)*	(0.193)	(0.639)***
Domestic investments as % of GPP	0.161	0.201	-0.068	0.057
	(0.087)*	(0.076)***	(0.046)	(0.149)
Public spending as % of GPP	0.095	-0.015	0.184	
	(0.127)	(0.111)	(0.067)***	
Population growth	-0.060	-0.047	0.008	-0.252
	(0.085)	(0.075)	(0.045)	(0.118)**
Gendered HC	0.002	0.002	0.011	0.221
	(0.001)*	(0.001)***	(0.021)	(0.076)***
Health as % of GPP	3.989	2.940	-1.968	-14.437
	(1.868)**	(1.647)*	(0.996)**	(3.765)***
Education as % of GPP	2.866	1.966	1.614	4.861
	(0.720)***	(0.637)***	(0.379)***	(1.117)***
Trade as % of GPP	0.100	0.096	0.011	-0.090
	(0.026)***	(0.023)***	(0.014)	(0.045)**
Industry as % of GPP	0.040	0.120	-0.015	
	(0.032)	(0.028)***	(0.017)	
Initial GPP per capita				0.304
				(0.111)***
Science as % of GPP				21.791
				(7.163)***
Transportation as % of GPP				6.446
				(1.800)***
Community projects as % of GPP				-6.536
				(1.205)***
Administration as % of GPP				-2.107
				(0.555)***
Observations	279	279	279	279
R2	0.50	0.52	0.95	0.47

Notes: All independent variables are lagged one period. Standard errors in parentheses; * significance at 10%; ** significance at 5%; *** significance at 1%. Foreign and domestic investments, public spending, health, education, science, transportation, community projects, administration, and industry are all first differenced. Population data in the estimation of the employment gap is calculated as the ratio of female-to-male provincial population.

6 Economic Significance

Estimates of economic significance allow us to compare the relative magnitudes of our results across independent variables; while some variables may exhibit statistical significance, their economic impact may be inconsequential. Using a slight alteration of the process outlined by Miller and van der Meulen Rodgers (2008), we calculate economic significance as the product of one standard deviation of the independent variable, the estimated coefficient in the simultaneous equation estimation, and gendered mean employment.[17] Each entry in Table 6 can be viewed as the number of additional employed persons (or the change the gendered employment gap), given an increase in the independent variable by one standard deviation.[18]

Using path analysis similar to that of Klasen and Lamanna (2009) and Dollar and Gatti (1999), economic significance estimates include the direct, indirect, and total effects (the sum of the direct and indirect effects) of each independent variable.[19] Direct effects illuminate the relationship between the dependent variable and gendered employment/the gap (Table 5, columns 1-3). For example, the direct effect of a one standard deviation increase in spending on healthcare is about 11,400 female employees, and is calculated as the product of 0.202% (one standard deviation, found in Appendix A), 3.989 (the coefficient on healthcare found in Table 5), and 1.42 million employees (mean female employees, found in Table 1).

Indirect effects illustrate how the dependent variables relate to economic growth (Table 5, column 4), which in turn relates to employment growth. To calculate these effects, first compute the direct effect of each dependent variable on growth (the product of the variable's estimated coefficient in the economic growth estimation and a one standard deviation increase in the variable). Next, calculate the direct effect of this increase in economic growth on gendered employment. For example, a one standard deviation increase in science expenditures is correlated with economic growth in the amount of 1.56% (the product of the coefficient on science expenditure in the economic growth model, 21.79, and a one standard deviation change in the variable, 0.072%), which is associated with an additional 5,200 female employees (the product of the 1.56% increase in economic growth, the coefficient on growth in the female employment model, 0.236, and mean female employment, 1.42 million). Thus, we conclude that a one standard deviation increase in science expenditure is indirectly correlated with an additional 5,200 female employees.

Economic growth directly increases employment for both genders where a one standard deviation increase in economic growth is associated with an additional 25,700 and 37,600 female and male employees, respectively, and raises the gendered employment gap by 0.5% illustrating that despite the larger increase in male employees, the process of economic growth increases gender equality, as measured by the gap. In analyzing the gendered effects of the determinants of growth, we find that a one standard deviation increase in trade as a share of GPP is directly correlated with an additional 54,200 and

[17] Our estimation differs from that of Miller and van der Meulen Rodgers (2008) as we use the mean value of gendered employment, while they use the mean value of the original dependent variable.

[18] Standard deviations of the transformed variables (including logs and differences) can be found in Appendix A.

[19] Consistent with other studies of path analysis, we use the term "effects" though differ in that our usage does not imply causation, but correlation.

Table 6: Economic Significance

1 standard deviation change in:	Female employment (increase in employees)			Male employment (increase in employees)			Gap (change in the gap)		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Growth	**25,714**		**25,714**	**37,634**		**37,634**	**0.5%**		**0.5%**
Foreign investments as % of GPP	2,025	**3,055**	5,080	**(7,088)**	**4,471**	**(2,617)**	0.1%	**0.1%**	0.1%
Domestic investments as % of GPP	**7,429**	(1,623)	5,806	**15,254**	(2,375)	12,880	-0.2%	0.0%	-0.3%
Trade as % of GPP	**54,222**	**(11,517)**	**42,705**	**85,615**	**(16,855)**	**68,759**	0.4%	**-0.2%**	0.2%
Industry as % of GPP	5,333		5,333	**26,315**		26,315	-0.1%		-0.1%
Public spending as % of GPP	2,943		2,943	(764)		(764)	**0.4%**		**0.4%**
Gendered HC	**343**	**11,603**	**11,946**	**286**	**16,982**	**17,267**	0.2%	**0.7%**	0.9%
Health as % of GPP	**11,452**	**(9,781)**	**1,670**	**8,440**	**(14,316)**	**(5,875)**	**-0.4%**	**-0.2%**	**-0.6%**
Education as % of GPP	**17,315**	**6,931**	**24,245**	**11,877**	**10,143**	**22,021**	**0.7%**	**0.1%**	**0.8%**
Science as % of GPP		**5,225**	**5,225**		**7,647**	**7,647**		**0.1%**	**0.1%**
Transportation as % of GPP		**11,422**	**11,422**		**16,717**	**16,717**		**0.2%**	**0.2%**
Community projects as % of GPP		**(10,319)**	**(10,319)**		**(15,102)**	**(15,102)**		**-0.2%**	**-0.2%**
Administration as % of GPP		**(11,236)**	**(11,236)**		**(16,445)**	**(16,445)**		**-0.2%**	**-0.2%**

Notes: Entries in **bold** indicate statistical significance.

85,600 female and male employees, respectively and a 0.4% increase in the gap. While the indirect effects are negative due to the relationship between trade and economic growth, the total effects are positive implying that trade may represent an avenue which increases gender equality, through upward harmonization. While our chosen measure of gender equality indicates a positive relationship between gender equality and trade, we acknowledge that trade may be negatively associated with gender equality when measured by relative wages.[20] These results illustrate how the relationship between macro variables and gender equality can be dependent on the economy's structure (the level of employment segregation, wages, and discrimination) and the chosen measurement of equality (employment or wages). While future research may aim to test the direct effect of trade on women's wages, our conclusions—based on gender equality in employment—indicate that trade is positively associated with gender equality.

Indirectly, gender equality in education is positively correlated with economic growth, employment for both genders, and the gap. A one standard deviation increase in gender equality in education is correlated with an additional 11,600 and 17,000 female and male employees, respectively, and a 0.7% increase in the gap. This result confirms previous empirical studies which argue that gender equality in education is growth enhancing (Klasen and Lamanna, 2009), and illustrates a possible macroeconomic policy which can increase gender equality while achieving development goals.

Conversely, the process of industrialization exhibits a stronger association with male than female employment as a one standard deviation increase in industrial output as a share of GPP is correlated with an additional 5,300 female urban employees, 26,300 male employees, and a fall in the gap of approximately 1.0%. This robust result, in combination with the intense gendered occupational segregation in China, supports the argument by Braunstein (2012) where industrialization in the Chinese economy of late has shifted towards the de-feminization of the workforce. Along similar lines, domestic investment as a share of GPP is positively related to gendered employment growth and negatively related to the gap at statistically significant levels. These findings illustrate macroeconomic policies which may promote economic growth while reducing gender equality in employment.

In analyzing the gendered employment effects of the categories of public spending, we find that a one standard deviation increase in spending on science is indirectly correlated with an additional 5,200 and 7,600 female and male employees, respectively, and an increase in the employment gap of 0.1%. Spending on transportation, on the other hand, is indirectly correlated with approximately 11,400 and 16,700 female and male employees, respectively, and a 0.2% increase in the gap, confirming previous results (Wamboye and Seguino, 2012).

We find a one standard deviation increase in public spending on healthcare directly correlated with an additional 11,400 and 8,400 female and male employees, respectively. While the impact appears larger for women's employment, the effect on the gap refutes this claim—public spending on health is associated with decreasing gender equality in employment. These conflicting results indicate that the relationship between this element

[20] As illustrated by Seguino (2000), if this increase in trade results in women's employment in export industries where wages are purposefully lowered in order to induce greater export competition, then an increase in trade may indicate downward pressure on gender equality, measured by relative wages.

of social infrastructure and gender equality is inconclusive.[21]

Alternatively, education spending is associated with increases in employment for both genders (both directly and indirectly), the gap, and economic growth—a result we find robust across all specifications.[22] The total effect of a one standard deviation increase in education spending as a share of GPP is an additional 24,200 and 22,000 female and male employees, respectively, and a 0.8% increase in the gendered employment gap. These larger positive effects on women's relative employment may be due to the impact of social infrastructure spending on short-run labor demand, via employment in care sectors, and labor supply, via the reduction in unpaid labor burdens, in the short and long-runs, effects which exhibit greater theoretical significance in female than male employment estimations.

7 Policy Implications

The results above indicate that these short-run gendered-employment effects of education spending may be bolstered by long-run impacts on productivity and growth. Increasing women's employment increases income controlled by women which is more likely to be spent on children's health and nutrition. Such spending impacts children's ability to obtain human capital, affecting long-run productivity and economic growth. These extrinsic reasons for raising gender equality in employment join the intrinsic reasons where equality is a good in-and-of itself.

Further evidence relating gender equality and public spending on education identifies such spending as being positively associated with equality in human capital accumulation, which has two significant consequences for policy makers. First, the larger increase in female human capital accumulation—which implies an increase in gender equality in education—is positively associated with economic growth, confirming the results found by Klasen and Lamanna (2009). Second, such an increase in female human capital may allow women to accumulate the capital needed to acquire jobs in the industrial sector which are otherwise out of reach, possibly helping to reduce the male bias inherent in industrialization.[23]

These results support the 'win-win' scenario proposed by Seguino, Berik, and van der Meulen Rodgers (2009) and Braunstein (2008) and confirm the theory put forth by Elson (1995). Placing greater emphasis on public spending on education increases economic growth in the short and long-runs, via growth impacts of fiscal policy and productivity gains, respectively, while also increasing gender equality both in the short-run (via labor supply and demand) and the long-run (via labor supply) in such a way as to strictly avoid downward harmonization of male employment.

This argument for increasing the allocation of GDP towards a category of public

[21]Future studies may further evaluate this relationship by instrumenting for healthcare spending, or possibly disaggregating this spending category in order to better evaluate this relationship.

[22]The exception being the statistically insignificant coefficient on growth in the GMM estimation of the gap.

[23]Social restraints may prevent women from obtaining employment in the industrial sector (higher wages and benefits) despite their acquisition of the necessary human capital. Social protections should be included in concert with an increase in infrastructure spending in order to increase women's ability to access such positions.

spending may meet with opposition by those who argue that such spending would "crowd out" the private sector. However, crowding out "... ignores the likely possibility, especially in developing economies where market imperfections are extensive, that public investment can crowd in or encourage private investment, as when the public provision of infrastructure, education and training, or credit makes private investment opportunities more attractive" (Braunstein, 2012, p. 4). Therefore, crowding in is a more likely outcome than crowding out when placing greater emphasis on social infrastructure spending.

Lastly, we note that this shift in macroeconomic policy choices should be undertaken in concert with the strengthening of social institutions in order to provide protections and support for women in the labor market in the form of childcare, maternity/parental leave, and healthcare (Razavi, Arza, Braunstein, Goulding, and Cook, 2012). Such protections could help to prevent discrimination in wages, promotion opportunities, and employment, and reduce gender-based occupational segregation which would allow women to increase their labor supply and thus their bargaining power within the household (Braunstein, 2008; Berik, van der Meulen Rodgers, and Seguino, 2009). Our results and policy suggestions, in combination with these social protections, detail how developing economies can use public spending to improve the relative position of urban women in their economies while also reaching development goals.

8 Conclusion

In this paper, we analyze the role of social infrastructure spending in gendered employment creation in urban China using several econometric techniques. From the perspective of the intra-household bargaining literature, we argue that equality in employment increases women's bargaining power and thus, gender equality. Therefore, we model gendered employment growth—our proxy for gender equality—as a function of public spending on social infrastructure while controlling for demand, individual capabilities, and structural change. Finally, we provide economic significance estimations and discuss the policy implications of the results.

We find industrialization positively associated with urban employment for both genders, but negatively related to women's relative employment. Given that industrialization will likely continue to spread throughout the Chinese economy, if not countered, our results indicate that the relative status of women in this economy will decline over time. Future macro-policy decisions in developing economies should incorporate gender-sensitivity into their policies by considering the potential negative effects of industrialization on women's relative welfare and introducing additional stipulations to help counter this undesirable externality.

Our results provide a possible gender-sensitive solution as they indicate that one of the categories of social infrastructure spending can increase gender equality in employment. While the relationship between health expenditure and gendered employment is mixed, we find that education spending is positively associated with economic growth, the growth rates of female and male employment, and the gap. These results indicate that public spending on education may be used as a policy lever in developing countries, as such spending increases gender equality in the short-run (via its impact on both labor demand and supply) and the long-run (via its effect on the labor supply) in a way that is upward

harmonizing; it is also positively related to growth both in the long and short-runs due to its effects on productivity and fiscal policy, respectively. The results also support the theory of a virtuous cycle of gender equality and economic growth. Lastly, we argue that social protections should be implemented in concert with these policies in order to increase women's ability to capitalize on the additional labor market opportunities.

The results presented here provide policy guidelines which create long-term sustainable growth in a gender-sensitive manner in the context of developing countries. This research aims to highlight the importance of infrastructure spending and its relationship with gendered employment while bringing to light the impacts of structural change on gendered outcomes. It is hoped that this work will encourage further explorations of the ways in which gender considerations can be incorporated into public policy decisions.

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A Appendix: Descriptive Statistics of Transformed Variables

	Mean	Standard Deviation
Growth	11.7%	7.7%
D.ln(Population)	-0.002	3.0%
D.Public spending as % of GPP	0.9%	2.2%
D.Science as % of GPP	0.0%	0.1%
D.Transportation as % of GPP	0.1%	0.5%
D.Community projects as % of GPP	0.1%	0.5%
D.Health as % of GPP	0.1%	0.2%
D.Education as % of GPP	0.1%	0.4%
D.Administrative as % of GPP	0.5%	1.6%
D.Foreign investment as % of GPP	0.1%	0.5%
D.Domestic investment as % of GPP	2.9%	3.3%
Trade as % of GPP	29.0%	38.2%
D.Industry as % of GPP	5.8%	9.4%
D.ln(female employment)	-0.002	0.04
Female HC	19.2%	12.1%
D.ln(male employment)	0.002	0.04
Male HC	22.9%	10.1%
F-to-M HC	80.0%	15.7%
Gap	-11.9%	7.8%

Notes: Means and standard deviations calculated as annual averages from 1999 to 2009, and across all 31 provinces. Public spending (including aggregate and disaggregated spending categories), fixed assets, trade, and industry measured in billions of Yuan. Source: Employment data from author's calculations based on data from China Labour Statistical Yearbook (2000-2010); others from author's calculations based on data from China Statistical Yearbook (2000-2010).

B Appendix: Descriptions of Data

Variable	Description	Source
Female and male employment	The total number of female and male employees in urban units (the Labour Ministry) including workers with urban and rural (employed in their urban unit for at least six months) household registration, not including not-on-post workers.	Author's calculations, CLSY Indicators: Female Employment [Number of Employed Persons] in Urban Units at Year-end by Sector and Region (2000-2010)
Population	The total number of people alive at midnight, the 3lst of December, within a given region not including Chinese nationals residing abroad and estimated by annual surveys of approximately 1% of the population using a stratified cluster sampling scheme (National Sample Surveys on Population Changes).	CSY Indicator: Household, Population, Sex Ratio and Household Size by Region (2000-2010)
Urban population	Refers to all people residing in cities and towns, measured identically to that of total population.	CPESY Indicator: Population and Household in City by Region (2000-2010)

Inflation	Index calculated using a consumer price index (urban and rural households) with a base year of 2000 where each subsequent year equals the product of the yearly growth of CPI and the index of the prior year.	Author's calculations, CSY Indicator: Residents Consumer Price Indices and Retail Price Indices of Commodities by Region (2000-2010)
Gross provincial product	The value of final products produced by all resident units at market prices measured in 2000 yuan.	CSY Indicator: Gross Regional Product and Indices (2000-2010)
Science	Public expenditures related to basic and applied research, R&D, and their administrative expenses measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)
Transportation	Road, waterway, railways, civil aviation and postal service public expenses measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)
Finance	Public expenses related to financial intermediation, industry (mining, manufacturing, construction), commerce, and tourism supervision and administration measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)
Security	Public expenses on public security and national defense including police forces, public and state security, the court system (prosecution, justice and prisons), military (active force, reserve force, and militia), and scientific research on national defense and special projects measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)
Social welfare	Public expenses on retirement income, social safety nets, and the National Social Security Fund measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)
Community projects	Officially reported as "Development Expenditure," this includes public spending on projects aimed at supporting underdeveloped areas including the planning and management of urban and rural communities, public facilities, housing, sanitation, among other development projects measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)
Health	Public expenses including general medical and health services, women and children's health, disease prevention and control, health inspection and supervision, and rural health care measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)
Education	Government appropriation for education including the total allocation for education, capital construction and research measured in yuan at current prices.	CSY Indicator: Government Expenditures by Region (2000-2010)
Agriculture	Public expenses related to administrative agriculture, forestry, and water conservancy development measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)
Administration	Public expenses including the affairs of Peoples Congress, the Peoples Political Consultative Conference, and other political parties, reforms, statistics, taxation, audit, customs, human resources, discipline inspection and supervision, population and family planning, trade, intellectual property, oceanic administration, surveying and mapping, earthquake, ethnic affairs, religious affairs, affairs of Hong Kong, Macao, Taiwan, and Overseas Chinese measured in 2000 yuan.	CSY Indicator: Government Expenditures by Region (2000-2010)

Trade	The sum of exports and imports (goods transported through Chinese customs valued at free on board prices and services provided between resident and non-resident units) measured at the provincial-level in USD. Given the total value of trade in yuan, converting to 2000 yuan requires a calculation of each province's trade share of the country-wide total in USD as the product of the country-wide trade in 2000 yuan.	Author's calculations, CSY Indicator: Total Value of Imports and Exports by Location of Importers/Exporters (2000-2010)
Foreign investments	The volume of construction (including materials, technology and equipment) and the purchases of fixed assets financed by foreign borrowings, foreign direct investments and other foreign investments measured in 2000 yuan where foreign currencies are converted into Renminbi applying the current exchange rate.	CSY Indicator: Total Investment in Fixed Assets by Ownership (2000-2010)
Domestic investments	Includes fixed investments described above financed by domestic (non-state) funds, calculated as total investment in fixed assets less foreign funded fixed assets and state-owned fixed assets measured in 2000 yuan where foreign currencies are converted into Renminbi applying the current exchange rate.	Author's calculation, CSY Indicator: Total Investment in Fixed Assets by Ownership (2000-2010)
Industrialization	The total value of industrial products and services produced during the reference period in a given region measured in 2000 yuan.	CSY Indicator: Main Indicators of Industrial Enterprises above Designated Size by Region (2000-2010)
Female human capital	The percentage of female employees who have completed a minimum of senior level education.	Author's calculations, CLSY Indicator: Educational Attainment Composition of Female Employment by Region (2000-2010)
Male human capital	The percentage of female employees who have completed a minimum of senior level education.	Author's calculations, CLSY Indicator: Educational Attainment Composition of Male Employment by Region (2000-2010)
Female-to-Male human capital	The ratio of female human capital to male human capital.	Author's calculations, CLSY (2000-2010)

C Appendix: Correlation Matrices

Table 8: Model 1 Correlation Coefficients

	ln(Female employment)	ln(Male employment)	Gap	Growth	Trade as % of GPP	Foreign as % of GPP	Domestic investments as % of GPP	Public spending as % of GPP	ln(Population)	Health as % of GPP	Education as % of GPP	Industry as % of GPP
Growth	0.105	0.048	-0.011									
Trade as % of GPP	0.335	0.268	0.104	-0.063								
Foreign investment as % of GPP	0.103	0.069	0.081	-0.023	-0.001							
Domestic investment as % of GPP	0.021	0.119	-0.022	-0.340	-0.205	0.208						
Public spending as % of GPP	0.114	0.072	-0.283	-0.329	-0.038	0.016	0.192					
ln(Population)	-0.173	-0.210	-0.064	-0.440	0.205	-0.084	-0.140	0.037				
Health as % of GPP	0.109	0.128	-0.208	-0.342	-0.073	0.064	0.334	0.658	-0.096			
Education as % of GPP	0.100	0.100	-0.126	-0.564	-0.079	0.008	0.317	0.311	0.049	0.051		
Industrial as % of GPP	0.159	0.314	0.175	-0.481	0.084	0.259	0.552	0.140	-0.076	0.316	0.296	
Female HC	0.127			0.013	0.737	-0.022	-0.169	-0.122	0.199	-0.129	-0.188	-0.029
Male HC		0.055		-0.005	0.758	-0.004	-0.186	-0.156	0.183	-0.139	-0.205	0.017
Female-to-Male HC			-0.133	0.048	0.389	-0.034	-0.077	-0.105	0.159	-0.152	-0.123	-0.075

Notes:Growth, human capital, and trade variables are all lagged one period while all other variables differenced and lagged. "ln" signifies the natural log operator.

Table 9: Model 2 Correlation Coefficients

	growth	Initial GPP	ln(Population)	Domestic investment as % of GPP	Foreign investment as % of GPP	Female-to-Male HC	Science as % of GPP	Transportation as % of GPP	Community projects as % of GPP	Health as % of GPP	Education as % of GPP	Administration as % of GPP
Initial GPP	-0.022											
ln(Population)	-0.074	0.146										
Domestic investment as % of GPP	0.016	-0.123	-0.140									
Foreign investment as % of GPP	0.093	0.025	-0.084	0.208								
Female-to-Male HC	0.098	0.509	0.159	-0.077	-0.034							
Science as % of GPP	-0.325	0.168	0.045	0.111	-0.006	0.057						
Transportation as % of GPP	-0.292	-0.088	-0.006	0.050	-0.010	-0.101	0.284					
Community projects as % of GPP	-0.471	0.076	-0.007	0.090	0.007	0.014	0.575	0.235				
Health as % of GPP	-0.369	-0.131	-0.096	0.334	0.064	-0.152	0.375	0.747	0.281			
Education as % of GPP	-0.009	-0.115	0.049	0.317	0.008	-0.123	0.069	-0.222	0.321	0.051		
Administration as % of GPP	-0.490	-0.104	-0.003	0.181	0.026	-0.113	0.561	0.764	0.651	0.701	0.131	
Trade as % of GPP	-0.019	0.812	0.205	-0.205	-0.001	0.389	0.238	-0.046	0.102	-0.073	-0.079	-0.064

Notes: Initial GPP is measured as is while trade and human capital variables are lagged one period and all other variables are differenced and lagged one period. "ln" represents the natural log operator.

Table 10: Model 3 Correlation Coefficients

	D.ln(Female human capital)	D.ln(Male Human Capital)	D.ln(Female-to-Male human capital)	Female HC	Male HC	Female-to-Male HC
Human capital (level)	0.113	0.144	0.181			
Education as % of GPP	0.125	0.092	0.132	-0.130	-0.130	-0.083

Notes: Expenditure on education is measured as the difference of the natural log lagged once. "D" and "ln" refer to the difference and natural log operators, respectively.