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Drivers of gendered sectoral and occupational segregation in developing countries

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DRIVERS OF GENDERED SECTORAL AND OCCUPATIONAL SEGREGATION IN DEVELOPING COUNTRIES

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Occupational and sectoral segregation by gender is remarkably persistent across space and time and is a major contributor to gender wage gaps. We investigate the determinants of one-digit occupational and sectoral segregation in developing countries using a unique, household-survey based aggregate data base including 69 developing countries between 1980 and 2011. We first show that occupational and sectoral segregation has increased in more countries over time than it has decreased. Using fixed effect panel regressions, we find that income levels have no impact on occupational or sectoral segregation. Rising female labor force participation is associated with falling sectoral but increasing occupational segregation; rising education levels, either overall or for females relative to males, tends to increase rather than decrease segregation.

Keywords: occupational segregation, sectoral segregation, gender, developing countries

JEL Codes: J16, J24, J31, J71, B54

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I. INTRODUCTION

The past few decades have seen dramatic reductions of gaps in education, and considerable reductions in gender gaps in labor force participation in developing countries (Klasen, 2016; Gaddis and Klasen, 2014); but despite this progress, gendered occupational and sectoral segregation has exhibited surprising persistence (World Bank, 2011). Whether or not equalization of education and labor force participation translates into increasing economic equality for women and bargaining power within the household depends importantly on the quality of jobs women work in.

Here one narrative has been that women workers, though drawn into the labor force in increasing numbers, are often concentrated in the worst jobs—i.e. those with the lowest pay, the worst working conditions, under flexible contracts and with no benefits—and are the first to be laid off, forming a flexible buffer labor force (Anker, 1998; Standing, 1999; Seguino, 2000; Charles and Grusky, 2004; World Bank, 2011). This segregation can furthermore lead to crowding which can reduce the pay and bargaining power of female workers (Bergmann, 1974; Caraway, 2007, 2; Charles and Grusky, 2004). Thus persistent sectoral and occupational segregation might reduce many of the benefits for women of higher labor force participation.

In particular, econometric analyses of gender wage gaps show that they are heavily affected by occupational and sectoral segregation. In fact, some studies suggest that most of the gender wage gaps are due to this rather than women being paid less than men in the same sector and occupation (World Bank, 2011; Simón, 2012; Blau and Kahn, 2006). In fact, as shown by Weichselbaumer and Winter-Ebmer (2005), the unexplained portion of the gender wage gap, which is closely related to occupational and sectoral segregation, has not fallen at all from 1963-

1997 (while the explained portion as well as the overall gap has fallen substantially). Moreover, sectoral and occupational segregation can also explain differences in working conditions, workplace protections, benefits, health risks, opportunities for advancement and types of contracts. Further, such segregation limits the efficiency and flexibility of labor markets which can be seen as having widespread economic and social costs.

Given these consequences of gender labor market segregation, it is surprising that the literature on drivers of gender-based occupational and sectoral segregation in developing countries is rather scarce. This paper will contribute to the existing literature in several respects. First, it will update the literature on the extent of occupational and sectoral segregation as the bulk of existing studies on developing countries has not been updated past 2000, largely due to data availability. Our micro-data based aggregate database allows us to provide a more up-to-date and broader impression of levels and trends in segregation across the developing world. Second, it uses three different segregation measures—two aggregate indices and one that breaks down the sectoral employment distribution by gender—to give a more comprehensive and nuanced understanding of the current state of gendered labor market segregation in developing countries. Third, most previous studies utilized cross-section regressions with low numbers of observations. Here, we use more comprehensive fixed-effects panel econometric models using all of our segregation measures to give a robust study of the factors affecting changes in the levels and trends in gendered labor market segregation over time. This allows us to tackle one important source of endogeneity, time-invariant unobserved heterogeneity. Lastly, we perform regressions across three different samples—national age 18-64, urban age 18-64, and national age 30-54—to further understand the dynamics of segregation across age and urban/rural residence.

We find that sectoral and occupational segregation is increasing slightly over time. Our regression results suggest that market forces and the convergence in labor force participation rates and education between men and women in developing countries are not eroding gendered labor market segregation. We find no evidence that rising incomes will erode gender-based occupational or sectoral segregation. Our findings also suggest that rising female labor force participation has differential effects for sectoral and occupational segregation, decreasing the former while increasing the latter. This implies that the increasing female labor force participation in developing countries is leading to a more even distribution of men and women across sectors, but into a limited number of occupations within these sectors. Education—both in terms of the average level and the ratio of female-to-male—increases segregation and displays differing significance between occupations and sectors, results counter to theories that gendered employment segregation largely reflects skill based differences between male and female workers.

Interesting differences emerge in our regression analysis with the restricted urban sample and 30-54 age cohort that yields further understanding of how the process of industrialization affects gendered segregation and how this segregation varies over the life cycle. Our results indicate that in urban areas, the average level of education and sectoral structure of the economy are more significant in gendered labor market segregation than in the full sample, and female labor force participation less so. For the 30-54 age cohort, sectoral structure is less significant and there is far more age variation in gendered sectoral than occupational segregation.

This paper is organized as follows: section II reviews the economic theories about gendered labor market segregation; section III reviews the empirical literature; section IV presents the measures of segregation that will be used; section V discusses the dataset, the

descriptive statistics for the covariates and segregation measures, and the methodology that will be used in the econometric analysis; section VI presents the econometric results and a discussion with respect to the theory; section VII concludes with policy implications and directions for further research.

II. THEORIES OF GENDER SEGREGATION

Here we will outline the main economic theories that could explain gendered labor market segregation and identify drivers of change to create the framework for our econometric analysis.

In Becker's neoclassical theory, gender differences in employment come either from different skill investments of men and women or different preferences, which are taken as exogenous. As men and women have different comparative advantages regarding household production and child-bearing and child-rearing, it follows that women will tend to concentrate on home labor and men in market labor (Becker, 1981). Gendered sectoral and occupational segregation follows from this as this specialization means that women will make fewer investments in human capital. When women do increasingly engage in market work they will self-select for those sectors and occupations in which there are lower human capital requirements and which are more flexible regarding intermittent labor force participation and working part-time, with implications for a gender wage differential based on different marginal productivities (see e.g. Polacheck, 2006). This is a supply-side based theory of gendered labor market segregation as it reflects the different choices of workers in creating patterns of gendered segregation across occupations and sectors.

A related, though distinct strand of literature in neoclassical theory, deals with different exogenous preferences between men and women, particularly with regard to "risk-aversion" that leads to different labor market decisions. Through controlled experimentation, differences between men and women are tested across a wide range of behavioral traits such as propensity to take risks, altruism, reaction to competition, trust, cooperation, spending and investment decisions, *inter alia* (see Croson and Gneezy, 2009 for a review). The bulk of this behavioral economics literature has highlighted that women tend to be more "risk-averse" than men. As a result, women will self-select for occupations and sectors perceived as less risky and/or they are less likely to take risks to bargain for higher remuneration or advancement, resulting in gendered segregation in the labor market and gender wage gaps (ibid). There is on-going debate regarding the robustness of these findings as well as the origin of these differences (e.g. Nelson, 2012; Booth and Nolan, 2009; Charness et al, 2013, Finucane et al.2000)

On the demand side, discrimination by employers has been canonized in neoclassical economic theory with Gary Becker's (1957) formalization of employers' "taste for discrimination." Employers who have discriminatory preferences will pay for their "taste for discrimination" . In competitive markets, the discriminating employers will be forced to change their hiring practices or go out of business. Market power/economic concentration shelters these discriminatory employers, so that enhanced competition will decrease the ability of employers to discriminate and thus gendered segregation should erode over time due to competitive forces.

This theory has been the subject of much empirical investigation, mostly with regard to gender wage gaps, finding results which both support and counter Becker's theory (Black and Brainard, 2002; Berik et al, 2004; Kongar, 2006; Oostendorp, 2010). One response to discriminatory employers is that women will predominantly work in firms with non-

discriminatory employers. So this theory would predict segregation between employers but not make clear predictions about segregation in sectors and occupations. The same holds for employee discrimination which, in Becker's theory, would also lead to segregation between firms, but not necessarily between sectors and occupations.

Institutionalist segmented labor market theories argue that labor markets are divided, often into dual "primary" and "secondary" labor markets, with different job characteristics and limited mobility between them, which operate both horizontally and vertically within occupations and sectors (Doeringer and Piore, 1971; Reich et al, 1973; see Anker, 1998 for a discussion). Employment in the "primary" sector is characterized by higher wages, greater job security, better working conditions, more stable employment and job ladders compared to employment in "secondary" sectors. These theories indicate the tendency of labor markets to be segmented by both race and gender, due to "typing" of jobs along both of these lines and the historical evolution of labor markets (Reich et al, 1973). Male workers, and in many cases, white male workers, have been preferred for "primary" sector jobs as historically they have had greater access to education, have had more experience and there has been a "male breadwinner bias" that has prioritized these occupations for men (Anker, 1998; Barker and Feiner, 2004). Women have generally been thought of as secondary wage earners, with feedback effects between fewer labor market options, lower wages and less opportunity for advancement and women's investments in human capital and labor force participation (ibid).

Feminist economic theorists have particularly emphasized the role of gendering, both in the supply and demand side of gendered labor market segregation, and in institutions. On the supply side, socialization of appropriate gender attributes for one's sex throughout a lifetime shape education and labor market decisions. Far from exogenous, women's unequal

opportunities and outcomes in labor markets shape these decisions regarding education and labor market participation, creating feedback loops that only slowly unravel over generations. Further, there are numerous constraints faced by women to participate equally in market work that do not necessarily reflect preferences and which serve to perpetuate socioeconomic inequality. The gendered division of labor regarding child care and the caring reproductive labor in the home leads to markedly different time use patterns between men and women, with women spending a disproportionate time performing the unpaid labor in the home and seeing less leisure time (World Bank, 2011). As women's participation in market employment has increased across the world, this has not been fully compensated with greater participation of men in the unpaid labor in the home, reflecting how deeply entrenched gendered ideologies are regarding market and domestic work and (ibid). This analysis extends to labor markets as "gendered" institutions that reflect sociocultural norms regarding gendered skills and content of jobs (Elson, 1999).

Though a gender division of labor is ubiquitous across countries, the gender typing of jobs is far from universal, showing significant variation both within and across countries over time (Boserup, 1970; see Cartmill, 1999 for discussion; Charles and Grusky, 2004; Caraway, 2007). Charles and Grusky (2004) argue that "gender essentialism" and the attribution of these gender norms to task content within jobs is at the root of horizontal gendered occupational segregation between the manual and non-manual sectors (15). This is not a static process, with the gender composition of the workforce also influencing the evolution of the task content for a given occupation (ibid, 17). Employers are subject to the same forces of gendered socialization, often reinforcing through hiring practices the established gendered hierarchies of work, whether through conscious discrimination or unconscious adherence to societal gender norms. If employers make decisions based on the average skills of men or women or stereotypes regarding

aptitudes, this “statistical” discrimination will enforce gendered segregation in occupations and industries regardless of the skills of the individual (Goldin, 2006). Similarly, workers internalize these social norms and may fight to preserve the status of their occupation or industry by active exclusion, a notion that has been formalized into a “pollution” theory of discrimination (ibid).

These divergent theories then generate different hypotheses regarding causal factors in processes of change of gendered labor market segregation that we will take to the data. The neoclassical theoretical perspective predicts would generally predict decreasing levels of gender labor market segregation over time due to changes in both the above mentioned supply and demand factors. Particularly, rising educational attainment, strong fertility decline and rising labor force participation of women in developing countries coupled with increased exposure to international competition, we would expect to witness corresponding decreases in our segregation indices in countries over time. Patterns of differential employment should persist only to the extent that they reflect differences in preferences and/or associated human capital investments which would be expected to decline aswell(Jacobs, 1989; Blau et al, 2006). We would then expect a negative relationship between economic development, export propensity, female labor force participation, and education covariates with our segregation measures, and a positive relationship with fertility. Structural change might also reduce segregation, as women’s economic opportunities are likely to be stronger in manufacturing and services.

Following from the institutionalist and feminist economic theories discussed, there is not necessarily any tendency for development to reduce gendered labor market segregation. The staying power of gendered labor market segregation as compared to other aspects of gender inequality is then conditioned by the complexities in interactions between the abovementioned supply and demand side factors. If labor markets are rigidly segmented along gender lines or by

job queues, increasing labor market participation by women could even increase segregation. Even as women achieve extensive gains in education, persistent norms can exhibit a "stickiness" or "path dependency" that becomes difficult to change (Caraway, 2007, 98). When these patterns do shift and women make inroads into previously male-dominated occupations, there is a tendency for some sectors or occupations to "feminize" past parity, while others remain male-dominated (Reskin and Roos, 1990; Charles and Grusky, 2004; Caraway, 2007). Greater gender equality across many dimensions may therefore be quite compatible with the perseverance or even intensification of gendered labor market segregation.

III. EMPIRICAL LITERATURE REVIEW

The bulk of empirical work regarding gendered labor market segregation has focused on developed countries, but here we will focus on the econometric studies that have analyzed drivers of gendered employment segregation in developing countries.

Empirical analyses of the relationship between economic development and gendered labor market segregation do not find support for the erosion of such segregation due to economic growth. In their descriptive analysis of 100 developing countries from 1993 to 2009, the World Bank (2011) found that the structural changes in employment did not lead to subsequent decreases in gendered employment segregation. Other studies that have included developing countries have either found a significant positive relationship between per capita GDP and gendered labor market segregation measures (Jacobs and Lim, 1992; Ball, 2008) or no significant relationship (Anker, 1998; Semyonov and Jones, 1999; Chang, 2004; Swanson, 2005).

Only two cross country studies that include developing countries have explored the role of economic openness, using the export share as a possible proxy for exposure to competition. Meyer (2003) found a significant and negative relationship between the export share and gender occupational segregation for 56 developed and developing countries from 1970-1990, and Chang (2004) found no significant relationship for 16 developing countries for 1990.

Structural change has been investigated in some studies. However, neither Semyonov and Jones (1999) or Chang (2004) found the size of the service sector to be significant in determining levels of occupational segregation in their cross-country studies including developing countries, though Charles (1992) did find a positive relationship for industrialized countries.

Among demographic variables, one would expect that high fertility is associated with greater occupational and sectoral segregation. This expected relationship has been verified in the econometric studies for developing countries, but not consistently. Jacobs and Lim (1992), Anker (1998) and Ball (2008) found a significant and positive relationship between fertility and occupational segregation, while both Chang (2004) and Swanson (2005) did not find any significant relationship.

Whether increased female labor force participation will translate into decreasing gendered labor market segregation depends on the underlying factors driving the segregation and the dynamics of change in labor markets. Cross-country empirical studies including developing countries have focused on the relationship with occupational segregation and have found a range of results, though most have shown significant and negative relationships (Jacobs and Lim, 1992; Anker, 1998; Semyonov and Jones, 1999; Meyer, 2003; Ball, 2008). Chang (2004) found no significant relationship and Swanson (2005) found a significant and positive relationship.

One problem in studying the link between labor force participation and occupational and sectoral segregation is that some of the indices of segregation used are sensitive to changes in the overall labor force participation rate while others are not. This issue is taken up below.

Regarding education, studies using women's relative education as a covariate have largely not found a significant relationship (Semyonov and Jones, 1999; Meyer, 2003; Chang, 2004; Swanson, 2005), with the exception of Jacobs and Lim (1992) who found a significant and positive relationship.

In sum, the empirical literature has not found clear and consistent patterns of the drivers of levels and changes in occupational and sectoral segregation. Much of this is related to the poor availability of data on this issue as well as the methods used to study the problem. In particular, most of the studies have been cross section regressions with a small number of observations, and which compare countries of vastly different levels of development and employment structures. They cannot account for unobserved country characteristics. In addition, most of the studies also are quite dated in terms of the data they rely on. The vast majority have also focused on occupational segregation, and neglected sectoral segregation. In the following, we use an updated and much broader data set as well as fixed effects panel regressions to control for (time-invariant) unobserved heterogeneity across countries to explore drivers of change in levels and patterns of both occupational and sectoral gender segregation.

IV. MEASURES OF GENDER SEGREGATION

Sectoral segregation measures horizontal segregation across sectors of the economy, while occupational segregation also includes vertical segregation as some occupations occupy different positions in a hierarchy. Attempts to understand changing patterns of gendered labor

market segregation have led to the creation of a multitude of composite indices that attempt to reduce the different magnitudes and proportions of men and women in different occupations and sectors down to a single index value that can be the basis of comparison over time and across countries. The benchmark has been the index of dissimilarity (ID), or the Duncan Index (Duncan and Duncan, 1955; Anker, 1998; Watts, 1998; Charles and Grusky, 2004; Blackburn, 2009). Given the prevalence of its use in the literature, we will calculate it as a means of comparison and updating previous studies; but to yield further information and robust results, we also calculate the Karmel and MacLachlan (IP) Index. Please note that the values of the indices are sensitive to the number of occupational and sectoral categories considered, with a larger number of categories usually leading to higher values and more dispersion in the values of indices across countries (Anker, 1998). We will stick to the same number of occupational and sectoral categories for all countries in our analysis below.

The Duncan index of dissimilarity is given by:

$$(1) \quad ID = \frac{1}{2}\sum_{i}\left|\frac{M_i}{M} - \frac{F_i}{F}\right|$$

where M_i and F_i are the numbers of men and women working in sector i, respectively, and M and F are the total number of men and women in the labor force. It gives the percentage of men or women that would have to change sectors without replacement to result in an equal distribution of men and women across all sectors. The values range from 0, which would indicate no segregation and an equal distribution of women and men across sectors, to 1, which would be indicative of complete sectoral segregation.

This easily accessible interpretation and its simple calculation have both been significant in the widespread usage of this index in the literature. An added advantage is that the index is not

mechanically sensitive to changes in female labor force participation rates. If the share of women in the labor force doubled but the distribution of women across sectors stayed the same, then the Duncan Index would not change which seems sensible. But there are also limitations. As the equation looks at the difference between male and female shares of a given occupation or sector of the total, it is heavily influenced by large sectors/occupations and therefore sensitive to cross-national differences in the size of occupations and sectors. If an economy is dominated by one sector and that sector is highly segregated, but the other smaller sectors are very equal, it would yield a higher value than if the dominant sector was very equal and numerous small sectors were highly segregated. If a large sector that is highly segregated shrinks in size over time, this would mechanically lower the value of the index even though the drivers of segregation might not have changed at all. In this way it gives an understanding of how the majority of male and female workers experience segregation, but not how segregated all the sectors of the economy are.

As mentioned, numerous attempts have been made by scholars in the segregation field to operationalize alternatives to the index of dissimilarity that remedied its shortcomings. One prominent one is the Karmel and MacLachlan (IP) that is not sensitive to the size of occupations and industries. The formula for the IP index is as follows:

$$(2) \quad IP = \frac{1}{N}\sum_{i}\left|\left(1-\frac{M}{N}\right)M_i - \frac{M}{N}F_i\right|$$

where N is the total employed population and the other variable definitions are the same as the index of dissimilarity. The range of index values is from 0 to .50, with a similar interpretation, but with an important difference. Here, too, the index value represents the percentage of men or women that would have to change sectors to result in an equal distribution of men and women

across the labor force, the IP keeps the sectoral distribution and the size of the overall labor force constant and looks at the percentage that would need to change *with* replacement.[1] This makes it, however, sensitive to changes in female labor force participation: If the number of women entering the labor force increases as sectoral segregation stays constant (i.e. the newly entering women are entering the labor force in exactly the same proportion as the existing distribution of females), the proportion of women that would need to change industries would increase more and lead to a rise in the index value (Watts, 1998; Salardi, 2012). In fact, it can be shown that the IP index has the following mathematical relationship to the ID:

$$(3) \quad IP = 2\left(\frac{F}{N}\right)\left(1 - \frac{F}{N}\right) ID$$

This weighting scheme implies that the IP will equal ½ of the ID when the male and female shares of total employment are equal. Some have argued that it only trades one form of margin dependence (to the size of sectors) for another (overall female labor force participation) (Charles and Grusky, 1998; 2004), but Watts (1998) has argued that this index and particularly the decomposition of it best satisfies the desirable criteria for a segregation index.[2][3]

V. DATA AND METHODOLOGY

This analysis uses the International Income Distribution Database (I2D2), a World Bank data set that harmonizes over 600 household surveys from 1980 to 2011, generally conducted by national statistics agencies, for over 120 countries (World Bank, 2013). The microdata are not

[1] In contrast, the ID gives a number without replacement, which allows for changes in the overall sectoral distribution of the labor force (e.g. if lots of women would have to shift to the construction sector to equalize representation there, that sector would grow, at the expense of the sector where the women came from).
[2] See Watts (1998; 2003) for further exposition.
[3] The Index of Association is another alternative that has been promoted in the literature (see Charles and Grusky, 2004) as a desirable alternative to the ID. We experimented with using this in our analysis, but ended up excluding it due to its intertemporal instability and thus inability to draw conclusions regarding drivers of change over time (see Watts 1998, 2003, for further discussion).

available but custom-made aggregate statistics have been produced for this analysis.[4] As these are surveys conducted at the household level, this dataset offers a wide range of labor market, demographic, education and standard of living variables (ibid). It is an unbalanced panel and not all countries report sectoral and occupational data and other countries did not report necessary labor market or demographic variables needed for our analysis, all of which reduced our sample size. We ended up with 69 developing countries that had some sectoral or occupational data with which to calculate our segregation indices: 24 from Sub-Saharan Africa, 20 from Latin America and the Caribbean, 10 from East Asia and the Pacific, 8 from South Asia, 5 from Europe and Central Asia, and 2 from Middle East and North Africa. While this is only a relatively small share of developing countries, our coverage of developing countries and more time periods is much larger than in the existing literature. Of particular note is our vastly improved coverage of poorer developing countries, including many more African countries.

To ensure comparability across countries, we have to rely on one digit sectoral and occupational categories reported in the I2D2 are as follows:

Table 1: I2D2 Sectoral and Occupational Categories

Sectors	Occupations
Agriculture	Senior Officials
Mining	Professionals
Manufacturing	Technicians
Public utilities	Clerks
Construction	Service and market sales workers
Commerce	Skilled agricultural
Transport and communications	Craft workers
Financial and business-oriented services	Machine operators
Community and family-oriented services	Elementary occupations
Other services	Armed forces

Source: World Bank (2013)

[4] We would like to thank Claudio Montenegro for generating and providing the aggregate data for our analysis.

Our data is disaggregated into rural and urban, so we perform our econometric analysis with both an aggregated national sample and a restricted urban sample.[5] Additionally, this data set is broken down into different age groups, and we also conduct our analysis on a restricted sample of the age group 30-54, often called the prime age group, where labor force participation rates are usually the highest and workers are largely unaffected by full-time education or early retirement.

The biggest limitation of our data is the highly aggregated nature of the occupational and sectoral categories, which give only a rather crude picture of gendered segregation. The calculated measures will provide a basis for comparison to previous studies and do allow insight into the big picture regarding levels and variation of gendered segregation in developing countries for the 2000s. Further, as we will be looking at what drives changes over time in levels of gendered labor market segregation, the level of aggregation is less important as aggregated measures have been shown to exhibit the same movements over time as index values based on more disaggregated data (Jacobs and Lim, 1992; Charles and Grusky, 2004).[6]

Table 2 contains the definitions, data sources and descriptive statistics for our segregation measures and covariates used in our analysis. Worth noting is that the I2D2 dataset allows us to calculate female labor force participation rates, education level and ratios, and sectoral employment shares directly from the microdata, a benefit in terms of consistency. Here, labor force participation includes informal employment, which is particularly important in analyzing women's employment outcomes. Further, this dataset allow us to calculate these specific to our

[5] We do not consider rural areas where agriculture is usually the dominant sector and occupational distinctions are small and not easily comparable across countries.

[6] Jacobs and Lim (1992) refer to this as the "parallel lines" hypothesis and find it holds for 9 out of 10 countries for which they test this hypothesis (460).

three different samples—national, urban, and a restricted national sample to the 30-54 age cohort. For the education covariates we are also able to calculate these with respect to the employed population directly from the micro data. This is an important advantage in analyzing to what extent human capital differences between men and women are driving gendered segregation in occupations and sectors, as there may be a difference between the female-to-male education ratio in the employed population versus the population at large.

Table 2: Variable Definitions, Sources and Summary Statistics

Variable	Source	Definition	Mean	Std. Dev.	Min	Max
Index of Dissimilarity (ID)	*International Income Distribution Database (I2D2)*	$\frac{1}{2}\sum_i \left\lvert \frac{M_i}{M} - \frac{F_i}{F} \right\rvert$	0.27	0.11	0.07	0.50
			0.24	0.12	0.08	0.50
Karmel and MacLachlan Index (IP)	*I2D2*	$\frac{1}{N}\sum_i \left\lvert \left(1 - \frac{M}{N}\right) M_i - \frac{M}{N} F_i \right\rvert$	0.13	0.05	0.03	0.25
			0.11	0.05	0.04	0.23
Per capita GDP	*World Development Indicators (WDI)*	PPP, constant $2005	$4,445	366	$640	$13,784
Export Share	*WDI*	Exports as a % of GDP	0.35	0.18	0.10	0.86
Total Fertility Rate	*WDI*	Births per woman	3.67	1.62	1.2	7.2
Female Labor Force Participation Rate	*I2D2*	Female labor force participation as a % of total labor force participation	0.62	0.18	0.18	0.96
Female-to-Male Education Ratio	*I2D2*	Ratio of average number of years of female-to-male schooling, employed population	0.92	0.19	0.40	1.21
Male Education Level	*I2D2*	Average number of years of schooling, male employed population	7.85	2.27	2.87	15.60
Agriculture Employment Share	*I2D2*	Agriculture employment as a % of total employment	0.39	0.22	0.09	0.91
Manufacturing Employment	*I2D2*	Manufacturing employment as a %	0.10	0.07	0	0.42

Share		of total employment				
Commerce Employment Share	*I2D2*	Commerce employment as a % of total employment	0.17	0.08	0.01	0.46
Mining and Construction Employment Share	*I2D2*	Mining and construction employment as a % of total employment	0.07	0.04	0	0.24
Services Employment Share	*I2D2*	Services employment as a % of total employment	0.23	0.14	0	0.47
"Other" Employment Share	*I2D2*	"Other" employment as a % of total employment	0.02	0.05	0	0.26

Notes:
1. For the ID and IP the top rows for each are sector values and the bottom rows are for occupation values

Economic development is proxied using GDP per capita (PPP, constant $2005). For economic structure, we look at both economic openness (exports as a percentage of GDP) and the sectoral structure by calculating five employment shares—manufacturing, commerce, a combined mining and construction sector, services,[7] and "other" which is a catch all category for employment in sectors that did not fall into one of the 1 digit sectoral classification categories.[8] Fertility is included as a demographic variable, and we include three human capital related variables—female labor force participation, the female-to-male education ratio of the employed population and the average number of years of male schooling of employed males.[9]

Table 8 (in the Appendix) shows the break-down by region of the countries in our sample, as well as the regional covariate averages. Per capita GDP shows the greatest disparities, with Latin America and the Caribbean having values more than double that of East Asia and the Pacific, South Asia, and Sub-Saharan Africa. These averages also illustrate the great gains in

[7] Also a combined sector of the following five service categories: public utilities, transport and communications, financial and business-oriented services, family and community-oriented services, and other services
[8] We included "other" and dropped the agriculture employment share as they cannot sum to one for our econometric analysis.
[9] Please refer back to section III for a discussion of these covariates with relation to the theoretical and empirical literature.

education made by women in these regions in recent decades, with average years of schooling for women now slightly exceeding that of men in Eastern Europe and Central Asia and Latin America and the Caribbean, and nearing parity in East Asia and the Pacific and the Middle-East and North Africa. The few countries we have in our sample from Eastern Europe and Central Asia have far lower average fertility and the highest average education. Sub-Saharan Africa has the highest fertility and female labor force participation rate. The export share is highest in East Asia and the Pacific and Eastern Europe and Central Asia.

Table 3 shows the calculated sectoral ID and IP for our sample for the latest year available, listed from highest to lowest and revealing a wide range of values. The column "Δ from SID" indicates how the ranking of countries changes when ordered from highest to lowest value of the SIP. Positive values in this column indicate that the country moves to a higher number in the order of countries, indicating that it has a lower value of the segregation index with the IP measure. The magnitudes of the sectoral ID range from a high of 0.50 for Haiti, to a low of 0.08 for Chad, and for the sectoral IP from 0.25 for Haiti to a low of 0.04 for Chad.[10] This indicates the percentage of men and women that would have to change sector in order for there to be an even distribution across all industries without replacement for the ID and with replacement for the IP. The mean sectoral ID for our sample is 0.27 and for the sectoral IP is 0.13. There is a strong cross correlation between the ID and the IP, as is seen in the scatterplot in Figure 1 (Appendix). This implies that, with a few exceptions, there are not strong effects of the margin dependencies of sector size and female labor force participation of the ID and IP, respectively.

[10] Remember that the max for the IP is 0.50 and values will be exactly half of the ID when there is equal male and female labor force participation.

Table 3: Sectoral ID and IP Index Values, National Sample Ages 18-64

Country	Year	SID	SIP	Δ from SID	Country	Year	SID	SIP	Δ from SID
Haiti	2001	0.50	0.25		Senegal	2005	0.27	0.12	+5
Honduras	2009	0.46	0.23		Ukraine	2003	0.27	0.14	-5
Egypt	2006	0.44	0.19	+9	Bosnia and Herzegovina	2001	0.26	0.11	+6
Nicaragua	2005	0.44	0.23	-1	Congo, Rep.	2005	0.26	0.14	-11
Jamaica	2001	0.43	0.22	-1	Mali	2003	0.26	0.11	+5
Maldives	2004	0.43	0.21	-1	Sri Lanka	2008	0.26	0.12	+1
Belize	1999	0.42	0.19	+3	Gabon	2005	0.25	0.13	-8
Dominican Republic	2010	0.42	0.20	-2	Mauritius	2003	0.25	0.11	+3
Guatemala	2006	0.39	0.20	-2	Rwanda	2010	0.24	0.12	-4
Philippines	2010	0.39	0.19	+3	Nepal	2008	0.23	0.13	-9
Cape Verde	2007	0.38	0.19		Ghana	2005	0.22	0.10	+4
El Salvador	2008	0.38	0.20	-4	India	2009	0.22	0.09	+6
Pakistan	2007	0.38	0.12	+25	Comoros	2004	0.21	0.10	+1
West Bank and Gaza	2008	0.38	0.12	+28	Bhutan	2007	0.20	0.13	-16
Panama	2010	0.37	0.18	+1	Cambodia	2008	0.20	0.10	-2
Angola	1999	0.36	0.19	-7	Cameroon	2001	0.20	0.12	-14
Chile	2009	0.36	0.18	-3	Georgia	2010	0.20	0.10	-2
Venezuela	2003	0.36	0.17		Myanmar	2010	0.19	0.09	+1
Albania	2004	0.33	0.16	+1	Sierra Leone	2003	0.19	0.11	-7
Bangladesh	2005	0.33	0.07	+39	Indonesia	2010	0.18	0.08	
Mexico	2010	0.33	0.16		Vietnam	2008	0.18	0.08	+3
Uruguay	2010	0.33	0.17	-5	Uganda	2010	0.17	0.08	+1
Colombia	2010	0.32	0.18	-8	Kenya	2005	0.16	0.09	-5
Costa Rica	2009	0.32	0.15		Mozambique	2008	0.16	0.08	-3
Afghanistan	2007	0.31	0.16	-6	Thailand	2009	0.16	0.08	-3
Brazil	2009	0.31	0.15	-3	Laos	2008	0.13	0.07	
Bolivia	2008	0.30	0.14	-1	Ethiopia	2011	0.12	0.05	+2
Ecuador	2010	0.30	0.15	-3	Malawi	2005	0.12	0.07	-1
Macedonia, FYR	2005	0.30	0.13	+5	East Timor	2001	0.11	0.04	+5
Paraguay	2010	0.30	0.16	-8	Zambia	2003	0.10	0.05	+2
Peru	2010	0.30	0.14	-3	Tanzania	2009	0.09	0.06	-1
Mauritania	2008	0.29	0.12	+5	Vanuatu	2010	0.09	0.05	-1
Swaziland	2000	0.29	0.14	-4	Burundi	1998	0.08	0.05	-5
Togo	2006	0.28	0.14	-4	Chad	2003	0.08	0.04	-1
					MEAN		0.27	0.13	

Source: Authors' calculations based on World Bank (2013)

The calculated occupational ID and IP values show very similar ranges as compared to the sectoral ID and IP values for countries in which data was available (see Table 4).[11] The occupational ID ranges from a low of 0.04 for Jamaica to a high of 0.50 for West Bank and Gaza. The occupational IP also has the lowest value for Jamaica of 0.02, but the country with the highest value is Venezuela at 0.23. This similarity in ranges between the sectoral and occupational measures is reflected in very similar averages for both indices, 0.24 for the occupational ID and 0.11 for the occupational IP.

For both indices we observe slightly lower average levels of occupational than sectoral segregation, contrary to what has been observed in the literature (Anker, 1998). This is partly driven by the smaller sample of occupational data, as data was not available for most of the Latin American and Caribbean countries in our occupational sample, but data was available for most countries in East Asia and the Pacific, South Asia, and Sub-Saharan Africa, all of which have lower average index values (see Table 9, Appendix).[12] For when levels of gendered occupational and sectoral segregation are compared within countries and regions we find strong correlations between the two. Figures 2 and 3 and Table 9 (Appendix) illustrate this for countries and regions.

Table 4: Occupational ID and IP Values, National Sample Ages 18-64

Country	Year	OID	OIP	Δ from OID	Country	Year	OID	OIP	Δ from OID
West Bank and Gaza	2008	0.50	0.15	+14	Georgia	2010	0.20	0.10	-3
Venezuela	2003	0.48	0.23	-1	Mauritania	2008	0.20	0.08	+6
Marshall Islands	1999	0.45	0.19	+2	Swaziland	2000	0.20	0.08	+8

[11] Fewer countries reported data on occupations, so the full sample here is 47 as opposed to 68 for the full sectoral sample. All countries that reported occupational data also reported sectoral data, with the sole exception of the Marshall Islands. Thus, our sample of countries is 69 in total.

[12] We tested this by calculating the means for the sectoral ID and IP in a restricted sample of non-missing values of their respective occupational index values and the resulting means converged to 0.24 and 0.12, respectively.

Egypt	2006	0.42	0.19		Uganda	2005	0.20	0.10	-3
Ethiopia	2011	0.41	0.20	-3	Bhutan	2007	0.19	0.11	-10
Angola	1999	0.39	0.20	-3	Macedonia, FYR	2005	0.19	0.09	-1
Brazil	2009	0.36	0.18	-1	Mauritius	2003	0.19	0.08	+2
Maldives	2004	0.35	0.17		Comoros	2004	0.18	0.09	-6
Peru	2010	0.35	0.17	+1	Thailand	2009	0.18	0.09	-2
Bolivia	2007	0.34	0.17	-3	Sri Lanka	2008	0.17	0.08	
Mexico	2006	0.34	0.17	-2	Kenya	2005	0.16	0.09	-7
Cape Verde	2007	0.32	0.16	-1	Mozambique	2008	0.16	0.09	-6
Chile	2009	0.32	0.16	-1	Vietnam	2008	0.15	0.08	-1
Pakistan	2007	0.32	0.11	+8	Cambodia	2009	0.14	0.07	-1
Bosnia and Herzegovina	2001	0.31	0.15	-2	India	2009	0.14	0.07	-1
Philippines	2010	0.30	0.15	-2	Myanmar	2010	0.14	0.06	+4
Bangladesh	2005	0.29	0.06	+25	Vanuatu	2010	0.13	0.07	
Fiji	1996	0.27	0.11	+3	Sierra Leone	2003	0.12	0.07	-3
Senegal	2001	0.24	0.13	-2	Tanzania	2007	0.12	0.06	+2
Nepal	2008	0.23	0.12	-2	East Timor	2001	0.10	0.04	-1
Ghana	2005	0.22	0.09	+6	Zambia	2003	0.10	0.06	+1
Indonesia	2007	0.22	0.10	+2	Burundi	1998	0.08	0.04	-4
Cameroon	2001	0.21	0.12	-6	Jamaica	2001	0.04	0.02	
Gambia	1998	0.21	0.13	-9	MEAN		0.24	0.11	

Source: Authors' calculations based on World Bank (2013)

Of importance to this study is evaluating how gendered labor market segregation levels have evolved over time. Past studies have found evidence of some convergence among countries and improvements over time (see Jacobs and Lim, 1992; Anker 1998, 2003). When index values are compared within countries over time[13] both for occupations and sectors, we observe mixed results, but for the countries in our sample over this time period far more saw increasing occupational and sectoral segregation (see Table 5). As there is such a strong correlation between the ID and IP for both occupations and industries, it is not surprising that both yield such similar trends over time; but as the IP is not margin-dependent on occupational size (though it is by

[13] Note that this was not for a uniform year range or number of years given our data set. Any country for which there was more than one year of index calculation available was included here. Not all countries exhibited clear trends over time, either, as in some there were fluctuations. For consistency, the first and last year values were compared regardless of any fluctuations in between.

changes in female labor force participation), this adds credibility to the interpretation that in more countries than not, an increasing number of workers would have to change industries and occupations to result in an even distribution of male and female workers (both with and without replacement). Details on country-specific trends can be found in the appendix (Tables 12 and 13).

Table 5: Changes in Segregation Indices within Countries over Time

		Increasing	Decreasing	No change
Sectoral	ID	24	16	8
	IP	28	9	11
Occupational	ID	13	11	4
	IP	15	6	7

Source: Authors' calculations based on World Bank (2013)

To the best of our knowledge, the empirical literature regarding gendered occupational and sectoral segregation for developing countries cuts off around the year 2000. Table 10 (Appendix) provides a summary of past empirical work from the early 1990s for developing countries (where the number of countries is marked with an asterisk indicates both developed and developing countries were included) and compares our results to them and finds them to be largely consistent with previous estimates when they overlap.[14]

Separating our country sample into regional averages reveals some interesting differences across continents (see Table 9, Appendix). Latin America and the Caribbean countries and the two countries in the Middle East and North Africa have the highest average levels of gendered sectoral and occupational segregation across both indices, consistent with some previous findings regarding Latin America (see Anker 1998 for a review). East Asia and the Pacific and Sub-Saharan Africa countries have the lowest average level of both sectoral and occupational

[14] Some authors use calculations of the ID and IP that multiply the equation by 100 to get in percentage terms, here we convert them to decimals for ease of comparison across studies.

segregation. Eastern European and Central Asian countries and countries in South Asia have average sectoral and occupational segregation in the middle in our sample. The regional consistency in ordering based on both sectoral and occupational segregation is striking in Table 9. This indicates there is a large correspondence between levels of sectoral and occupational segregation that is being driven by some strong regional force, perhaps sociocultural norms embedded in gendered patterns of work. The number of countries within regions is also important to note here, as overall our sample is dominated by Sub-Saharan Africa, one of the regions with lower segregation, particularly for the occupational sample.

Sectoral and occupational data were used to calculate the two indices and concentration ratios across our three samples: national age 18-64, urban age 18-64, and national age 30-54. We then used these indices as dependent variables in panel regression analyses to control for time-invariant unobserved heterogeneity across countries and to understand the covariates associated with changes in gendered occupational and sectoral segregation over time. The following equation was estimated using an OLS fixed-effects panel[15] across all three of our samples:

$$(5)\quad \ln(Seg_{it}) = \alpha_i + \beta_1 \ln(\text{gdppc}_{it}) + \beta_2 \ln(\text{exgdp}_{it}) + \beta_3 \ln(\text{tfr}_{it}) + \beta_4 \ln(\text{flfpr}_{it}) + \beta_5 \ln(\text{edratio}_{it}) + \beta_6 \ln(\text{edmale}_{it}) + \beta_7 \ln(\text{othershare}_{it}) + \beta_8 \ln(\text{mfrshare}_{it}) + \beta_9 \ln(\text{cceshare}_{it}) + \beta_{10} \ln(\text{macshare}_{it}) + \beta_{11} \ln(\text{sershare}_{it}) + \varepsilon_{it}$$

where Seg_{it} is the measure of segregation for country *i* at time *t* and is estimated for the index of dissimilarity (ID) and the Karmel and MacLachlan index (IP) for both occupations and sectors, and for the concentration ratios for agriculture, manufacturing, commerce, mining and construction, and services. We estimate the equation using the natural logs of our dependent and independent variables because our index values are bounded between zero and one and so that

[15] A Hausman test was performed to confirm the use of a fixed effects rather than a random effects specification.

the regression coefficients can be interpreted as elasticities. Due to the presence of heteroskedasticity in our data we estimated our regressions using robust standard errors.

Given the complexities of gendered labor market segregation, it is important to mention the possibility of endogeneity. We are able to control for one source of endogeneity, time-invariant unobserved heterogeneity, through our fixed effects setting. Another source, reverse causality, is unlikely to be relevant for most covariates including GDP, sectoral structure, export share or education, although it is not implausible that occupational and sectoral segregation influences female labor force participation or fertility. Lastly there can be time-varying unobserved heterogeneity, i.e. some time-varying variable affects both dependent and independent variables. For example, one might imagine that unobserved value change regarding gender affects female labor force participation, education, fertility, and occupational or sectoral segregation. Such value change would plausibly lead to a spurious negative correlation between female labor force participation and education and segregation (and spurious positive relation between fertility and segregation). It is less clear whether there are unmeasured time-varying third variables that simultaneously affect GDP and segregation. In short, we cannot rule out some forms of endogeneity so that one has to be careful to assume all measured effects are causal.

VI. RESULTS

Across all of our samples—national, urban, and 30-54—our measure of economic development (GDP per capita, ppp) is not a significant determinant in changes in gendered occupational or sectoral segregation (see Tables 6-7). This is consistent with the aforementioned narrative put forth by the World Bank (2011), among others, that economic development alone is not a powerful force in integrating labor markets along gendered lines. We in fact find positive

(though insignificant) coefficients on this covariate for both the ID and the IP, suggesting that as countries get richer, gendered segregation remains entrenched or even becomes more entrenched, as suggested by some of the institutionalist and feminist theories. There are a multitude of forces working to increase and decrease gendered segregation throughout the development process, many of which are crystallized in institutions and social norms that have dynamic interactions with the very process of development. Thus we cannot rely on economic forces alone to erode entrenched patterns of gendered labor market segregation.

Table 6 (below) displays our regression results for the ID and the IP for sectoral (denoted SID and SIP) and occupational segregation (OID and OIP). There are smaller sample sizes for occupations than for sectors, as fewer countries had occupational data,[16] and as data on covariates was missing for some of the countries for which we calculated segregation indices, the sample size is smaller—60 countries for sectors and 38 for occupations. The insignificance of per capita GDP was already discussed, but it is also worth noting that we find no significance for the export share, either. This is an interesting result considering the bulk of literature discussing export openness and gendered segregation particularly in export manufacturing sectors; however as this also includes primary product exports it may be too crude of a measure. Overall there is great consistency in the results of the ID and IP regressions in terms of the signs and magnitudes of the coefficients on the covariates, though there are some differences in terms of the statistical significance of the female labor force participation rate and female-to-male education ratio covariates in the sectoral index regressions.

[16] For consistency we performed additional regressions restricting our sectoral ID and IP sample to non-zero values of the occupational ID and IP. This did lead to changes in magnitude and significance of our coefficients, but not to changes in sign and did not eradicate the differences between sectors and occupations, so we include the full sample regressions here.

We find female labor force participation to exhibit differences in sign and magnitude between occupations and sectors. Our results suggest that increasing female labor force participation is associated with women spreading more equally across sectors, but into a limited number of occupations, thus decreasing segregation in the former and increasing it in the latter. Since the ID is not sensitive to segregation-neutral increases in female labor force participation, this suggests that more women in the labor force reshapes the distribution of males and females

Table 6: National 18-64 Sectoral and Occupational ID and IP Regression Results

	Dependent Variable: Segregation Index			
Explanatory Variables	SID	SIP	OID	OIP
GDPpc	0.09	0.08	0.11	0.13
	(1.12)	(0.99)	(0.73)	(0.75)
Export Share	0.04	-0.05	0.20	0.18
	(0.98)	(-1.15)	(1.25)	(1.08)
Fertility	-0.01	-0.17	0.34	0.25
	(-0.08)	(-0.88)	(0.73)	(0.50)
FLFPR	-0.24**	-0.16	2.24**	2.27**
	(-2.40)	(-1.47)	(2.25)	(2.20)
Education Ratio	0.37**	0.24	0.19	0.20
	(2.42)	(1.32)	(0.40)	(0.36)
Average Education	0.02	0.03	0.42***	0.41***
	(1.08)	(1.34)	(3.96)	(3.19)
Other ES	-0.002	-0.003**	-0.001	-0.0001
	(-1.43)	(-2.31)	(-0.52)	(-0.31)
Manufacturing ES	0.03	0.04	0.14*	0.12
	(0.54)	(0.77)	(1.76)	(1.40)
Commerce ES	-0.02	-0.01	-0.32***	-0.30**
	(-0.35)	(-0.18)	(-2.79)	(-2.17)
Mining and Const. ES	0.01	0.01	0.02	0.02
	(0.86)	(0.93)	(1.33)	(1.14)
Services ES	-0.14*	-0.17**	0.17	0.14
	(-1.76)	(-2.01)	(0.79)	(0.59)
Year 81-85	-0.06	0.01	0.77*	0.75*
	(-0.47)	(0.04)	(1.86)	(1.69)
Year 86-90	-0.11	-0.11	0.68**	0.65*
	(-1.01)	(-0.89)	(2.23)	(2.02)
Year 91-95	-0.04	-0.06	0.34*	0.25
	(-0.73)	(-0.92)	(1.79)	(1.16)
Year 96-00	-0.01	-0.01	0.22	0.23
	(-0.17)	(-0.23)	(1.53)	(1.44)
Year 01-05	-0.02	-0.01	0.10	0.11
	(-0.85)	(-0.48)	(1.44)	(1.37)

Constant	-1.64***	-2.26***	-1.35*	-2.10**
	(-4.88)	(-6.39)	(-1.78)	(-2.56)
Observations	328	328	151	151
Groups	60	60	38	38
R-Squared	0.35	0.28	0.55	0.51

Notes:

1. * p<0.1, ** p<0.05, ***p<0.01 (t-statistics in parenthesis)
2. SID and OID are the index of dissimilarity for sectors and occupations, respectively; SIP and OIP are the Karmel and MacLachlan indices for sectors and occupations, respectively; GDPpc=per capita GDP; Export Share=export/GDP; Fertility=total fertility rate; FLFPR=female labor force participation rate; Education Ratio=female/male education ratio; Average Education=average male education; ES=employment share. See Table 2 for a full list of variables and definitions.
3. Fixed-effects estimations are performed using robust standard errors.
4. The agriculture employment share and the years 2006-2011 are the left out categories.

across sectors. The IP would have, by construction (see equation 3), increased with a segregation-neutral increase so that we would expect a larger coefficient. We indeed find a larger coefficient, but it remains negative, supporting the reshaping of sectoral structures. Conversely, rising female participation increases occupational segregation, and is significant across both indices with much larger coefficients. Roughly a one percent increase in female labor force participation is associated with a two percent increase in occupational segregation, again supporting that it is reshaping the gender distribution across occupations. To the extent that occupational segregation says more about the gender differences in types of jobs, this suggests that increasing female employment pushes women increasingly into female-dominated jobs, even as sectors are becoming more gender balanced.

Our education variables also generate interesting results. Sectoral segregation appears to rise with higher female relative education, suggesting that more female education leads to more concentration of women in certain sectors. This could be related to educated women increasingly dominating commerce or certain service sectors (particularly health, education, and public service). Since this effect is not significant for the SIP index, it appears to be driven by large sectors. The effect of gender gaps in education does not translate to occupational

segregation where we find no effect. Here higher levels of average male education are associated with greater occupational segregation, suggesting that greater education levels generate more scope for gendered occupational hierarchies. These positive and significant effects of both relative female and average education levels in sectors and occupations are counter to the discussed human capital theories of gendered segregation, which suggested that more similar education levels would lower segregation.

We observe the same difference in the sign of the coefficients between our sectoral and occupational indices for fertility as we did for female labor force participation—negative for sectors and positive for occupations—though the magnitudes are small and not significant.

The ID and IP also have largely consistent results across all the sectoral employment shares. These were introduced as covariates to get an idea of how the structure of an economy effects gendered labor market outcomes. Increases in the employment share of commerce—the most female-dominated sector on average—has negative coefficients across both indices for sectors and occupations, though is significant only for the occupational indices regressions. This indicates that even though this is a relatively female-dominated sector on average, that employment expansion of this sector is associated with a more even distribution of women and men across occupations within that sector (and across the economy). This might indicate that (some) women are able to break through occupational glass ceilings in this heavily female-dominated sector. Increases in the services employment share are associated with decreases in gendered sectoral segregation. Important to remember is that the "services" category is an aggregation of five largely gender segregated sectors (see Table 11, Appendix), but this suggests that an expanding service sectors is an important entry point for women.

The year dummies suggest that there has been no secular trend on sectoral segregation. In occupational segregation, they suggest that, conditional on covariates, occupational segregation has fallen slightly over time. Other covariates (esp. rising average education, female labor force participation, and GDP/cap) would point to an increase in occupational segregation and this is slightly mitigated by the time trend.

In summary, we find no evidence that rising incomes reduce segregation. Female labor force participation reduces sectoral but increases occupational segregation, and education is associated with rising segregation. These results are derived for the 18-64 age group. We now turn to sub-samples to study some nuances in this relationship.

From the I2D2 dataset we are able to calculate the female labor force participation rate, the education variables, and the sectoral employment shares for urban areas (age 18-64). Urban/rural disaggregated data was not available for our other covariates: per capita GDP, exports as a percentage of GDP, and fertility. As the sectoral composition is likely to be different between rural and urban areas, we would expect these variables to exhibit different patterns and magnitudes of significance in the urban sample. Overall our results suggest that compared to the national sample, the average level of education and the sectoral structure of employment are more significantly correlated to both gendered occupational and sectoral segregation, and female labor force participation less so. And income levels have again no impact on sectoral or occupational segregation.

Interesting differences emerge in our regression results as compared to the national sample (Table 7a). In contrast to the national sample, we find that in urban areas a higher export share is associated with lower sectoral segregation, providing some support that exposure to trade generates opportunities for women across sectors. Female labor force participation is not

significant in relation to changes in either gendered sectoral or occupational segregation in this sample, the coefficients are smaller for occupational segregation, and the sectoral coefficients are no longer negative. This indicates that our overall results are driven by the impact of greater female participation on segregation within rural areas and between rural and urban areas, while within urban areas, female participation has little impact on sectoral segregation.

Table 7a: Urban 18-64 Sectoral and Occupational ID and IP Regression Results

	Dependent Variable: Segregation Index			
Explanatory Variables	SID	SIP	OID	OIP
GDPpc	-0.004	0.01	0.02	0.02
	(-0.006)	(0.10)	(0.14)	(0.14)
Export Share	-0.11*	-0.15**	0.18	0.17
	(-1.88)	(-2.38)	(0.97)	(0.91)
Fertility	0.35	0.28	1.06	1.22
	(1.17)	(0.95)	(1.27)	(1.21)
FLFPR	0.07	0.16	1.05	1.21
	(0.50)	(1.10)	(1.08)	(1.28)
Education Ratio	0.49	0.48	-0.09	-0.09
	(1.55)	(1.55)	(-0.12)	(-0.11)
Average Education	0.23***	0.23***	0.79***	0.80***
	(3.76)	(3.88)	(3.92)	(3.92)
Other ES	-0.001	-0.002	-0.01	-0.01
	(-0.23)	(-0.40)	(-0.97)	(-1.04)
Manufacturing ES	0.34***	0.34***	-0.24	-0.23
	(3.05)	(3.03)	(-0.77)	(-0.71)
Commerce ES	0.26*	0.26*	0.71**	0.70**
	(1.92)	(1.87)	(2.43)	(2.32)
Mining and Const. ES	0.19**	0.19**	0.25*	0.24*
	(2.36)	(2.26)	(1.97)	(1.84)
Services ES	-0.28	-0.29	-0.38	-0.35
	(-1.05)	(-1.05)	(-0.75)	(-0.70)
Year 81-85	0.18	0.18	-0.14	-0.13
	(0.85)	(0.87)	(-0.28)	(-0.27)
Year 86-90	-0.22	-0.22	0.12	0.12
	(-1.54)	(-1.54)	(0.37)	(0.36)
Year 91-95	-0.16	-0.16	0.16	0.16
	(-1.52)	(-1.46)	(0.76)	(0.78)
Year 96-00	-0.13	-0.12	0.04	0.04
	(-1.51)	(-1.47)	(0.30)	(0.30)
Year 01-05	-0.08	-0.07	-0.01	-0.004
	(-1.53)	(-1.36)	(-0.06)	(-0.04)
Constant	-1.05*	-1.77***	-2.34	-3.00*
	(-1.71)	(-2.94)	(-1.51)	(-1.92)

Observations	336	336	154	154
Groups	60	60	38	38
R-Squared: within	0.61	0.60	0.55	0.55

Table 7b: National 30-54 Sectoral and Occupational ID and IP Regression Results

	Dependent Variable: Segregation Index			
Explanatory Variables	SID	SIP	OID	OIP
GDPpc	0.07	0.05	0.22	0.26
	(0.92)	(0.74)	(1.33)	(1.31)
Export Share	0.08	0.02	0.44*	0.49*
	(1.32)	(0.32)	(1.90)	(1.74)
Fertility	0.18	0.14	-0.12	-0.27
	(0.79)	(0.57)	(-0.22)	(-0.43)
FLFPR	0.15	0.23	2.32***	2.53***
	(1.08)	(1.62)	(3.52)	(3.75)
Education Ratio	0.19	0.12	-0.17	-0.25
	(1.56)	(0.84)	(-0.85)	(-0.89)
Average Education	0.05*	0.05**	0.41***	0.39***
	(1.97)	(2.35)	(6.40)	(4.85)
Other ES	-0.002	-0.002	-0.01*	-0.01*
	(-0.98)	(-1.09)	(-1.84)	(-1.81)
Manufacturing ES	0.14	0.11	0.04	-0.03
	(1.55)	(1.19)	(0.15)	(-0.10)
Commerce ES	0.22	0.23	0.41	0.52
	(1.64)	(1.45)	(0.99)	(1.08)
Mining and Const. ES	0.08	0.08	0.07	0.09
	(1.13)	(1.11)	(0.97)	(0.96)
Services ES	-0.18	-0.23	-0.79**	-0.96**
	(-0.62)	(-0.65)	(-2.29)	(-2.27)
Year 81-85	0.001	0.03	-1.25***	-1.37***
	(0.01)	(0.20)	(-4.34)	(-4.21)
Year 86-90	-0.04	-0.09	1.09***	1.17***
	(-0.38)	(-0.77)	(3.09)	(3.94)
Year 91-95	0.01	-0.04	0.78**	0.79**
	(0.14)	(-0.39)	(2.58)	(2.27)
Year 96-00	-0.02	-0.05	0.44***	0.49***
	(-0.25)	(-0.84)	(3.12)	(3.11)
Year 01-05	-0.06	-0.08	0.09	0.09
	(-1.18)	(-1.42)	(1.16)	(0.99)
Constant	-0.75	-1.59***	0.17	-0.28
	(-1.50)	(-3.33)	(0.19)	(-0.28)
Observations	336	336	152	152
Groups	60	60	38	38
R-Squared: within	0.43	0.36	0.43	0.42

Notes:
1. * p<0.1, ** p<0.05, ***p<0.01 (t-statistics in parenthesis)

2. SID and OID are the index of dissimilarity for sectors and occupations, respectively; SIP and OIP are the Karmel and MacLachlan indices for sectors and occupations, respectively; GDPpc=per capita GDP; Export Share=export/GDP; Fertility=total fertility rate; FLFPR=female labor force participation rate; Education Ratio=female/male education ratio; Average Education=average male education; ES=employment share. See Table 2 for a full list of variables and definitions.
3. Fixed-effects estimations were performed using robust standard errors.
4. The agriculture employment share and the years 2006-2011 are the left out category.

In terms of our education covariates, we would expect that these might be more significant in urban areas that are more industrialized and have more opportunities for higher skilled employment and employment which requires more "brain than brawn." This then theoretically implies more possible employment opportunities for women given the scope of their educational attainment convergence with men. However, insomuch as higher skilled employment is associated with better quality and higher paid employment also subjects this employment to the "male breadwinner bias" and "job queuing" that socially constructs these jobs as preferable for elite male workers. Further, industrialization has seen strongly gendered patterns of work, such as female workers in export manufacturing, which suggests gendered segregation may intensify in urban areas and as the workforce becomes more educated/ skilled. The average level of education covariates confirms this as it has larger positive coefficients as compared to the national sample and is significant across both indices for both sectors and occupations. The female-male education ratio has an (insignificant) positive impact on sectoral segregation and none on occupation segregation. This suggests that as the workforce becomes more educated/skilled, gendered sectoral and occupational segregation significantly intensifies.

Our sectoral employment shares exhibit larger coefficients and greater significance in the urban sample, not surprising given that urban areas have more developed manufacturing, construction, and commerce sectors. Here our regression results indicate positive and significant correlations of the commerce, manufacturing, and mining and construction employment shares

covariates with gendered sectoral segregation in that order of magnitude. The commerce and combined mining and construction employment shares have positive and significant coefficients for our occupational segregation indices, as well. Commerce was the most highly female dominated sector on average, and mining and construction the most male dominated on average relative to the gender composition of the labor force, and this suggests that the expansion of these sectors is not only intensifying that sectoral gendered segregation, but also into gendered occupations within these sectors. Compared to the national sample, the service sector employment share is no longer significant in decreasing sectoral gender segregation.

Like for the urban sample, the I2D2 dataset lets us calculate female labor force participation, education and sectoral employment shares specific to this age group. Overall our regression results indicate that sectoral employment structure is far less significant for this prime working age cohort than for the full or urban sample. We also find there is more age variation in drivers of gendered sectoral than occupational segregation, particularly for average education level, and the signs of our fertility and female labor force participation variables.

Table 7b shows the regression results for the 30-54 age cohort. Again, income levels play no role in affecting occupational or sectoral segregation. In this age group, a rising export share is associated with greater occupational segregation suggesting that among this prime age group, exposure to trade intensifies gendered hierarchies and occupational stratification. We observe that the coefficient on the fertility and female labor force participation covariates both become positive for the sectoral segregation indices, but they are small in magnitude and insignificant. But higher female labor force participation is still associated with higher occupational segregation, suggesting that women enter the urban workforce at the bottom rungs of hierarchies.

Average education emerges as more significant for gendered sectoral segregation than the full sample, as was also found for the urban sample. This suggests that for this age cohort, as the average education/skill base of the workforce increases, female workers are working in increasingly feminized sectors, such as commerce. That this would be more significant for those in the middle of their working lives and who are at the cusp of the increases in educational attainment in developing countries, particularly for women, makes sense.

That sectoral employment structure is not a significant driver of either sectoral or occupational gender segregation in this age cohort is an interesting result. This implies that structural change has differential effects by age cohort, and that it does not have a significant effect women as compared to men workers on those in the prime working age group.

VII. CONCLUSIONS AND FURTHER RESEARCH

This paper has painted some broad strokes regarding the current state of gendered occupational and sectoral segregation in developing countries. The use of two different segregation indices, the Index of Dissimilarity (ID) and the Karmel and McLachlan Index (IP), along with concentration ratios across five sectors has yielded updated measures regarding the level and pattern of such segregation in a wider sample of countries and time periods than has been considered to date. We have seen a wide range in levels of gendered occupational and sectoral segregation across 10 categories for the developing countries in our sample and observed significant differences across regions, with Latin America and the Caribbean and Middle East and North Africa at the higher end for both industries and occupations and East Asia and the Pacific and Sub-Saharan Africa at the lower end for both. This was an interesting finding in that there was such a strong cross correlation between levels of sectoral and occupational segregation, though our econometric analysis showed some different forces driving changes in

levels for these two types of gendered segregation over time. The significance of regions in levels and patterns of both occupational and sectoral segregation is indicative of both structural forces and social norms in their determination. Our results also indicate that changes over time within the majority of the countries in our sample indicates that gendered labor market segregation is increasing, both in sectors and occupations.

Using our indices as dependent variables in our panel regression analysis yielded an array of interesting results regarding what drives changes over time. Of great interest is that we did not find economic development to be significant covariates in our analysis across any of our samples. Openness to trade is also mostly insignificant although it slightly lowers sectoral segregation in urban areas and increases occupational segregation among prime-age workers. This is generally in contrast to neoclassical theory that predicts that market forces and economic development will erode discrimination and instead indicates that changes in the structure of employment and enhanced competition do not eliminate the driving forces behind gendered segregation in employment. However, these results are not inconsistent with men and women having different preferences and "risk-aversion," another strand of neoclassical theory, and are also consistent with institutionalists and feminist economics theories.

A second set of important findings revolve around the effect of female labor force participation. It reduces sectoral segregation in our overall sample, and increases it occupational segregation across samples. This we cannot be sure that increasing female participation will do much on its own to reduce segregation.

Our education variables have positive coefficients across all of our samples, which runs counter to the predictions of human capital theory and points to larger structural-social forces at play in driving gendered segregation. Our results indicate education—both the average level and

the gender ratio—to have a larger effect for occupational segregation, and for the average level to be more significant for sectoral segregation in both the restricted urban and 30-54 age cohort samples than the full sample. The commerce and service sector employment shares were the most significant in changes in gendered segregation, with different effects across sectors and occupations, but indicating that the process of structural change in which these sectors develops merits further attention with regard to gendered outcomes.

A number of important policy conclusions emerge from these results. Most importantly, market forces alone are not a pathway to ending sectoral and occupational segregation. This analysis has reinforced feminist economic arguments that men and women experience processes of industrialization and structural change differently, both as workers in formal labor markets and in their responsibilities for unpaid labor. The extent to which this segregation is problematic depends on whether women workers are disadvantaged due to this segregation and face systematically lower wages, worse working conditions, and lower quality employment that does not reflect exogenous biological preferences but instead socially constructed gendered hierarchies of power and discrimination and different gendered constraints. If, as the literature has suggested, this is the case in developing countries, then guaranteeing gender equality in labor market outcomes must go beyond policies to improve women's education and formal labor market participation. These gender equality goals are important in their own right, but they are not sufficient in decreasing gendered labor market segregation, as in many cases we found improvements in these increase such segregation. Our results then suggest that a comprehensive policy approach to gender equality involves active support in breaking down segregation in unpaid and paid work, as the first constrains women's abilities to participate equally in the latter.

When thinking about policies, one can either focus on tackling sectoral and occupational segregation directly, or focus on one of its most serious consequences, large gender wage gaps. Tacking sectoral and occupational segregation will not be easy. It requires analyses of specific constraints that prevent women from moving into certain sectors or occupations. They can range from constraints related to family duties, esp. care activities, to formal and informal barriers of accessing certain sectors or occupations, social norms that prescribe women's roles in the economy, and the lack of mentors or role models. Experiences from industrialized countries show how difficult it is to successfully implement such policies, as occupational and sectoral segregation remains pervasive. But the whole range of programs, from mentoring by role models, to specific programs for girls and young women to help them choose typical male occupations and sectors, to quotas for leading occupations are among the toolbox to be considered.

Another approach is to focus primarily on addressing the problem of gender wage gaps that results from occupational and sectoral segregation. This can be addressed most successfully in systems where there is countrywide collective bargaining. Then policies such as comparable worth policies can be adopted where typical female jobs and male jobs are graded on the same roster of requirements, difficulty, and experience. Australia implemented such a policy in the 1970s which led to a substantial reduction in the gender wage gap. Of course, most developing countries have small formal sectors and little, if any, collective bargaining beyond the firm or the sector level. Thus there is little scope to influence the gender wage gap in the private sector directly. But the public sector in developing countries usually is a large part of the formal sector. So one avenue to address the gender wage gaps are to implement comparable worth policies within the public sector which may then also affect wage-setting in the private sector.

Gendered occupational and sectoral segregation continues to be extensive and exhibit persistence in developing country labor markets. This paper has contributed to an understanding of the state of such segregation, the patterns in sectors, and the variables correlated with changes over time. This is a valuable jumping off point for further research. Country level studies with more detailed occupational and sectoral data are needed to assess the extent of gendered occupational and sectoral segregation, as that is likely underestimated here using our 10 aggregated sectoral and occupation categories. Combining these measures with reliable wage data or measures of job quality would be useful to assess the remunerative consequences and effects of gendered labor market segregation in developing countries. Particularly the commerce sector seems important to investigate in terms of gendered wage outcomes, working conditions and types of contracts as it is the most female dominated sector in our sample. Also, investigations into the intersectionality of race and ethnicity with gender in levels and patterns of labor market segregation would be valuable contributions to our understanding of how power and socioeconomic hierarchies are embedded in labor markets in the global division of labor that characterizes our modern world.

VIII. APPENDIX

FIGURES

Figure 1: IID-IIP Cross Correlation

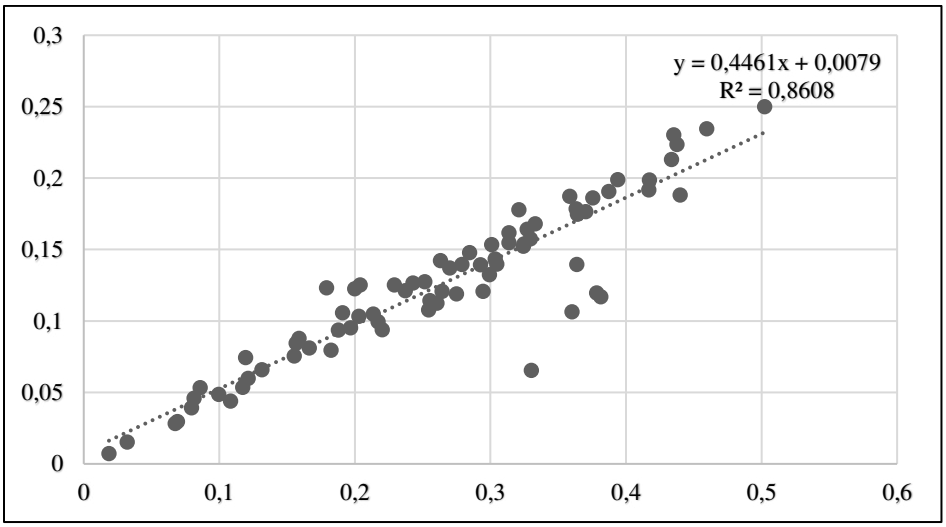

Figure 2: IID-OID Cross Correlation

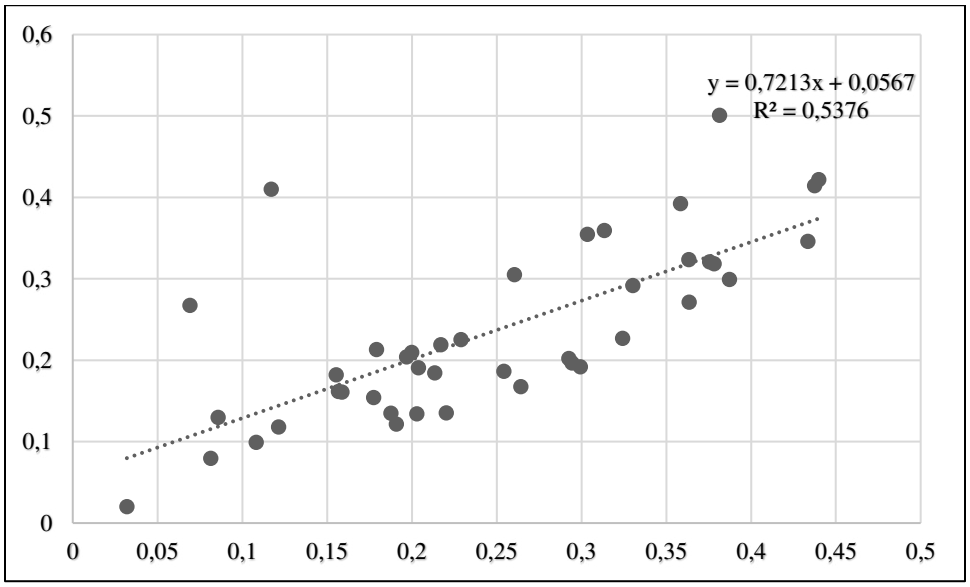

Figure 3: IIP-OIP Cross Correlation

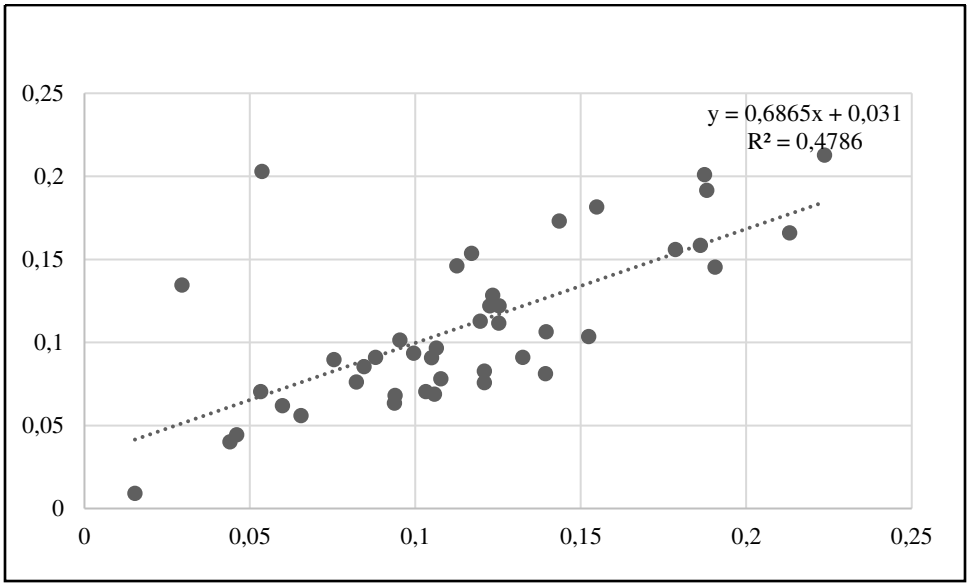

Table 8: Regional Covariate Comparisons

	East Asia and the Pacific	Eastern Europe and Central Asia	Latin America and the Caribbean	South Asia	Sub-Saharan Africa	Middle East and North Africa
GDP (PPP, constant $2005)	$3,337.21	$5,662.0	$7,607.58	$2,835.25	$2,396.70	$4,877.6
Exports (% of GDP)	0.44	0.40	0.33	0.28	0.35	0.30
Fertility Rate (births per women)	3.12	1.63	2.77	3.21	5.23	3.70
FLFPR	0.64	0.54	0.58	0.45	0.72	0.34
Female-Male Education Ratio	0.92	1.05	1.04	0.85	0.77	0.95
Number Years Male Schooling	7.57	12.46	8.41	6.96	6.54	10.12
Number of Countries	10	5	20	8	24	2

Source: World Development Indicators (World Bank, 2014) and I2D2 (World Bank, 2013)

Table 9: Regional Means for Gendered Sectoral and Occupational Segregation Indices

		ID	IP
East Asia and the Pacific	Sectoral	0.18	0.09
	N	*9*	*9*
	Occupational	0.20	0.09
	N	*8*	*8*
Eastern Europe and Central Asia	Sectoral	0.27	0.13
	N	*5*	*5*
	Occupational	0.23	0.11
	N	*3*	*3*
Latin America and the Caribbean	Sectoral	0.37	0.18
	N	*20*	*20*
	Occupational	0.32	0.16
	N	*7*	*7*
South Asia	Sectoral	0.30	0.13
	N	*8*	*8*
	Occupational	0.24	0.10
	N	*7*	*7*
Sub-Saharan Africa	Sectoral	0.21	0.10
	N	*24*	*24*
	Occupational	0.20	0.10
	N	*18*	*18*
Middle East and North Africa	Sectoral	0.41	0.15
	N	*2*	*2*
	Occupational	0.46	0.17
	N	*2*	*2*

Source: Authors' calculations based on World Bank (2013)

Table 10: Summary Statistics of Past Segregation Measures

	Year	# of Countries	#Occupations | Sectors		ID Range		IP Range	
Jacobs and Lim (1992)	1960-1980	56*	7	8	.10 -.59	.06 - .62		
Blau and Ferber (1992)	1988-1990	80*	7		.10 – .63			
Semyonov and Jones (1999)	1990	56*	7		.09 - .55			
Anker et al (2003)	2000	15*	55-149		.46 - .64			
Chang (2004)	1990	16	43		.39 - .72			
Charles and Grusky (2004)	1990	10*	64		.43 – .60			
Swanson (2005)	1990-2002	35*	76-135		.45 – .63			
Ball (2008)	1988-1992	49*	16-280		.44 – .70			
European Commission (2009)	1997-2007	27**	111	60	.43 – .65	.28 – .52	.21 – .32	.14 – .26

* Includes both developed and developing countries
**For the EU-27, included here just to provide some basis for comparison for our IP index values

Table 11: Disaggregated Services Summary Statistics

Sector	Mean	Std. Dev.	Min	Max
Public utilities	0.35	0.28	0	1.62
Transport and communications	0.18	0.15	0.01	0.75
Financial and business services	0.82	0.47	0.13	2.49
Community and family services	1.20	0.79	0.13	2.88
Other services	7.75	10.86	0	50.46

Source: Authors' calculations based on World Bank (2013)

Table 12: Sectoral ID and IP within Country Changes, First and Last Year Values

Country	Year	SID	SIP	Country	Year	SID	SIP	Country	Year	SID	SIP
Albania	2002	0.30	0.15	Ethiopia	1999	0.17	0.08	Pakistan	1992	0.30	0.08
	2004	0.33	0.16		2011	0.12	0.05		2007	0.38	0.12
Bangladesh	1999	0.42	0.19	Ghana	1998	0.27	0.13	Panama	1991	0.45	0.20
	2005	0.33	0.07		2000	0.22	0.10		2010	0.37	0.18
Belize	1993	0.39	0.18	Guatemala	2000	0.37	0.19	Paraguay	1990	0.31	0.15
	1999	0.42	0.19		2006	0.40	0.20		2010	0.30	0.16
Bhutan	2003	0.14	0.10	Honduras	1991	0.52	0.23	Peru	1997	0.31	0.15
	2007	0.20	0.13		2009	0.46	0.23		2010	0.30	0.14
Bolivia	1997	0.27	0.12	India	1993	0.16	0.08	Philippines	1997	0.36	0.18
	2008	0.30	0.14		2009	0.22	0.09		2010	0.39	0.19
Brazil	1981	0.37	0.17	Indonesia	1995	0.16	0.06	Senegal	2001	0.19	0.09
	2009	0.31	0.15		2010	0.18	0.08		2005	0.27	0.12
Cambodia	1997	0.14	0.08	Jamaica	1996	0.39	0.19	Sri Lanka	1993	0.21	0.09
	2008	0.20	0.10		2001	0.43	0.22		2008	0.26	0.12
Cameroon	1996	0.14	0.09	Kenya	1997	0.21	0.11	Tanzania	2006	0.10	0.05
	2001	0.20	0.12		2005	0.16	0.09		2009	0.10	0.05
Cape Verde	2000	0.33	0.16	Laos	2002	0.14	0.07	Thailand	1983	0.08	0.04
	2007	0.38	0.19		2008	0.13	0.07		2009	0.16	0.08
Chile	1987	0.39	0.17	Macedonia, FYR	2003	0.31	0.13	Uganda	2002	0.17	0.08
	2009	0.36	0.18		2005	0.30	0.13		2010	0.17	0.08
Colombia	2002	0.35	0.18	Mali	1994	0.22	0.10	Ukraine	2002	0.27	0.14
	2010	0.32	0.18		2003	0.26	0.11		2003	0.27	0.14
Costa Rica	1989	0.32	0.13	Mauritius	1999	0.29	0.12	Uruguay	2006	0.32	0.16
	2009	0.33	0.15		2003	0.25	0.11		2010	0.33	0.17
Dominican	1996	0.36	0.14	Mexico	1989	0.33	0.15	Venezuela	1989	0.36	0.16

Republic	2010	0.42	0.20		2010	0.33	0.16		2003	0.36	0.17
Ecuador	1994	0.24	0.13	Mozambi-que	1996	0.16	0.09	Vietnam	1993	0.15	0.07
	2010	0.30	0.15		2008	0.16	0.09		2008	0.18	0.08
Egypt	1988	0.32	0.15	Nepal	2003	0.23	0.13	W. Bank & Gaza	1998	0.44	0.10
	2006	0.44	0.19		2008	0.23	0.13		2008	0.38	0.12
El Salvador	1991	0.36	0.20	Nicaragua	1998	0.47	0.23	Zambia	1998	0.12	0.08
	2009	0.38	0.20		2005	0.44	0.23		2003	0.10	0.05

Source: Authors' calculations based on World Bank (2013)

Table 13: Occupational ID and IP within Country Changes, First and Last Year Values

Country	Year	OID	OIP	Country	Year	OID	OIP
Bangladesh	2003	0.33	0.11	Mauritius	1999	0.23	0.10
	2005	0.29	0.06		2003	0.19	0.08
Bhutan	2003	0.12	0.09	Mexico	1989	0.31	0.13
	2007	0.19	0.11		2006	0.34	0.17
Bolivia	2000	0.32	0.15	Mozambique	1996	0.16	0.09
	2007	0.34	0.17		2008	0.16	0.09
Brazil	1981	0.38	0.18	Nepal	2003	0.25	0.14
	2009	0.36	0.18		2008	0.23	0.12
Cambodia	1997	0.14	0.07	Pakistan	2005	0.30	0.10
	2009	0.14	0.07		2007	0.32	0.11
Cape Verde	2000	0.34	0.16	Peru	1997	0.35	0.17
	2007	0.32	0.16		2010	0.36	0.17
Chile	1996	0.33	0.15	Philippines	1997	0.40	0.20
	2009	0.32	0.16		2010	0.30	0.15
Egypt	1988	0.32	0.15	Sri Lanka	1993	0.17	0.07
	2006	0.42	0.19		2008	0.17	0.08
Ethiopia	1999	0.57	0.28	Tanzania	2006	0.11	0.06
	2011	0.41	0.20		2007	0.12	0.06
Ghana	1998	0.19	0.10	Thailand	1983	0.12	0.06
	2000	0.22	0.09		2009	0.18	0.09
India	1993	0.06	0.02	Uganda	2002	0.03	0.01
	2009	0.14	0.07		2005	0.20	0.10
Indonesia	1995	0.16	0.07	Venezuela	1989	0.48	0.20
	2007	0.22	0.10		2002	0.48	0.23
Jamaica	1996	0.05	0.02	Vietnam	1993	0.16	0.07
	2001	0.04	0.02		2008	0.15	0.08
Macedonia, FYR	2003	0.18	0.07	West Bank and Gaza	1998	0.47	0.12
	2005	0.19	0.09		2008	0.50	0.15

Source: Authors' calculations based on World Bank (2013)

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