The Impact of Strategically Allocated Family Planning Programs in Indonesia, 1986-94

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Abstract

In this paper, we investigate the effects of public family planning programs on fertility in Indonesia, controlling for economic growth and improvements in the status of women. A major stumbling block to measuring the impacts of family programs on fertility is that family planning programs are not randomly placed. Moreover, if, as in the case of Indonesia, the government allocates program inputs to areas of greatest need and updates the allocations based on performance, standard methods of controlling for this problem, such as fixed effects analysis, yield inconsistent estimates. We solve this problem by explicitly modeling the government's allocation process together with the impact analysis. Using these methods, we find that total BKKBN expenditures on contraceptive subsidies lowered fertility by about 3-6 percent. By contrast, a 50 percent improvement in the distribution network (including public health clinics and community-based distribution systems) lowered fertility by about 12 percent. However, these policies are expensive; BKKBN's contraceptive subsidies represent roughly 50% of their annual expenditures, while the costs of the distribution network are paid largely out of other ministerial budgets.

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0. INTRODUCTION

Population control is often cited as a key element in a country's ability to maintain and improve its economic and social welfare. While fertility reductions have been associated with general economic development, many governments have established explicit policies designed to reduce population growth. These policies include aggressive family planning programs and efforts to improve general education and economic opportunities for women. The 1994 United Nations conference in Cairo highlighted the fact that strong publicly financed family planning programs are critical elements of most countries' population control policies. The conference report recommended that the world triple its spending on family planning programs by the year 2010. Population programs continue to be emphasized by both multilateral aid agencies such as the World Bank, the regional development banks and the UN, and bilateral aid agencies such as USAID.

Yet debate still continues over the importance of family planning (FP) programs in contributing to fertility declines. The debate concerns several questions: when in the development process are FP programs most effective; which components of FP programs are most effective; and how effective are FP programs relative to other factors, especially improvements in women's educational and economic opportunities.[1] In this paper, we contribute to this debate by investigating the effects of an array of public family planning programs on fertility in Indonesia – a relatively mature developing country – while controlling for economic growth and improvements in the status of women.

A major stumbling block in measuring the impacts of family planning programs on fertility is that the programs are not randomly placed; governments tailor their programs to the local needs of the populations they serve. In the case of non-random placement, OLS regression coefficients reflect both the impacts of the government programs on fertility and the effect of fertility (and its proximate determinants) on government allocation decisions. "The direction of the bias introduced by non-random placement is not clear. On the one hand, it can have a downward bias on measured impacts in cross-sectional studies if governments target areas of greatest need. On the other hand it can have an upward bias if government supplies of contraceptives are

diverted to areas of greatest contraceptive demand – and they do not respond to local needs (Rosenzweig and Wolpin 1986).[2] But it can also have an upward bias if government supplies of contraceptives are only diverted to areas of Since this paper seeks to measure the impacts of multiple types of Indonesian family planning programs, including both contraceptive subsidies (which are not delivered to regions where they will not be used) and other contraceptive promoting activities (which, along with contraceptive subsidies, are routinely targeted to poorly performing areas,[3] we must explicitly deal with these limitations of OLS analyses.

With a few notable exceptions, previous studies of the impact of family planing on fertility assume that government family planning programs are randomly allocated or allocated in a way that is uncorrelated with fertility or its proximate determinants. Only a few studies have tried to control for the non-random targeting of program inputs. Schultz (1973), Montgomery and Casterline (1991), Pitt, Rosenswieg and Gibbons (1993) and Gertler and Molyneaux (1994) use panel data to estimate a fixed effects model to control for this endogeneity. This model essentially regresses changes in local birth hazards on changes in the explanatory variables. The fixed effects model controls for the endogeniety of program placement if the government allocates family planning program inputs based on fixed characteristics of the population. The fixed effects specification essentially differences these fixed characteristics out of the model and the error terms. As a result, changes in program variables are uncorrelated with changes in the error term.

Fixed-effects models may be appropriate for measuring the impacts of government interventions that do not dynamically respond to changing demand characteristics. Indeed, Gertler and Molyneaux's application used a limited five-year time frame, and focussed on the roles of relatively stable program interventions, such as clinics, distribution infrastructure, personnel, and contraceptive promotion activities. However, the study was unable to address the impact of contraceptive subsidy allocations, which respond quickly to changing contraceptive demand environments

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[1] See, for example, Hermalin (1975 and 1983), Freedman and Berelson (1978), Tsui and Bogue (1978), Mauldin and Berelson (1978), Demeny (1979), Bulatao and Lee (1983), Westoff et al. (1989), Schultz (1990), and Gertler and Molyneaux (1994).

[3] Indeed, several cross-sectional studies using Indonesian data found negative correlation between selected program inputs and contraceptive prevalence (Djuhari 1985; Lerman, et al. 1989; Molyneaux, et al. 1990).

and account for over half of all program costs (World Bank, 1990). In Indonesia the allocation of contraceptive subsidies are based, in part, on contraceptive use and, thus respond dynamically to program performance.

Angeles, Guilkey and Mroz (1998) allow for more complex allocation rules than the fixed-effects models require. They jointly model the determinants of the geographic allocation of family planning programs and the determinants of fertility. They apply an efficient, semi-parametric, random-effects estimator that allows for correlation between unobservables influencing program placement and the fertility outcome. Excluding some of the determinants of program placement from the fertility equation identifies their model. The excluded variables include lagged national and regional health and family planning expenditures. Such an identification strategy will not work in the Indonesian context where the government's family planning allocation process dynamically updates the allocations based on observed contraceptive use and fertility. In this case, lagged family planning program budgets are likely to be correlated with the error term in the fertility equation and are therefore not a valid identifying variable.

In this paper, we develop a method for estimating program impacts, despite this endogeneity. This method depends on a model of family planning resource allocation decisions that are made by the Indonesian government. The Indonesian family planning resource allocation process provides a set of valid instrumental variables that we use to estimate the impacts of the family planning program on fertility. Because provincial governments allocate resources across districts subject to an overall budget constraint, an increase in the allocation to one district reduces the amount that can be allocated to other districts. Therefore, variables that shift contraceptive demand in competing districts are valid instruments.

The paper is organized in five sections. In sections 1 and 2 we describe the institutional setting and data sources, respectively. Section 3 investigates the allocation of family planning program expenditures. We find that not only is the government's allocation of family planning not random, but it responds dynamically to contraceptive use. This implies that a simple fixed effects estimator is insufficient to control for the endogeniety of program placement. However, our analysis of the allocation rule does suggest a feasible identification strategy that allows us to estimate consistent impacts of these endogenous contraceptive subsidies. In section 4, we investigate the effects of family planning program inputs on fertility using a regression analysis based on this identification strategy. Finally, we summarize our findings and discuss the policy implications in section 5.

1. THE INSTITUTIONAL SETTING

Indonesia is an especially interesting country in which to study the determinants of fertility declines. It is the fourth most populous country in the world and has substantial ethnic, cultural and economic diversity. It is widely cited for its dynamic and innovative family planning program and has recently experienced rapid fertility declines. The government has also invested massively in education and infrastructure over the past two decades. During this study's time frame, Indonesia experienced substantial macroeconomic shocks, stemming from oil price booms and busts, aggressive deregulation of capital markets, and rapid expansion of export oriented manufacturing industries.

Also important for this study, the Indonesian Family Planning Coordinating Board (known by its Indonesian initials, BKKBN) experimented aggressively with different approaches to influencing fertility over the period studied here. These approaches include extensive promotion and education campaigns, development and training of contraceptive delivery systems and personnel, and procurement of contraceptives. Over this period, contraceptive use has grown rapidly and consistently, but the methods most commonly used have undergone a complex transition. This transition is characterized by a growing reliance on hormonal methods, principally at the expense of IUDs. The changing pattern of use probably reflects the compound impacts of a maturing and increasingly well-informed clientele, increasing levels of disposable income, improved transportation infrastructure, and a changing mix of contraceptive subsidies.

This analysis covers the years 1986 through 1994; a period of sustained, but decelerating fertility decline and rapid economic growth. It should be noted that the period covered by this analysis precedes the 1997/98 monetary crisis, and its subsequent recession. However, the findings of this study are immediately relevant for the policy choices BKKBN has had to make in the face of the crisis. At the beginning of our analysis period, Indonesia's fertility transition had been underway for over 15 years, though after 1986, the pace appears to have slackened. Total fertility rates (TFR) declined 22 percent over the 11 years from 1970 through 1980 and declined another 25 percent in the next nine years with much of the decrease occurring from 1980 to 1986 (CBS, 1991). Moderate declines continued from 1991 through 1994.

Historically, the vast majority of this fertility decline has been attributed to two proximate-determinants: a dramatic rise in contraceptive prevalence, and an increase in age of marriage (Adioetomo et al., 1990; Hull and

Hatmadji, 1990). The percent of women contracepting increased from 27 percent in 1980 to 47 percent in 1987, then rose more gradually to 50 percent in 1991 and 55% in 1994 (CBS, 1995). In addition, the mean age of marriage rose from 19.3 in 1971 to 21.1 in 1985 (Hull and Hatmadji, 1990).

Two important institutional factors are often cited for the changes in these proximate-determinants (Hull, et al., 1987; Hull and Hatmadji, 1990; World Bank, 1990): (1) expansion of economic welfare and opportunities of women, and (2) a strong government commitment, both political and financial, to limiting population growth through family planning.

Early improvements in economic welfare came about as a result of a rapid expansion of the education system, combined with occasional periods of strong economic growth. Primary school enrollment increased from 13 million in 1974 to 27 million in 1985, with enrollment rates reaching nearly 95% by 1994. Poverty rates fell from about 40 percent in the late 1970s to about 22 percent in the late 1980s (World Bank, 1989), reaching 13% by 1993 (CBS, 1994.) National household expenditure surveys indicate that price adjusted non-food expenditures increased by nearly 60 percent over the six year period from 1978 to 1984 (Lembaga Demografi, 1988). Real wage rates increased by 65 percent for women and by 40 percent for men between 1980 and 1987 (Ananta et al., 1990). More recently, wages have continued to increase, though at a slower pace. Over the period 1985 to 1993, real wages for both men and women increased by roughly 20%.

The Indonesian Government's commitment to limiting fertility is implemented through the National Family Planning Coordinating Board (BKKBN). For years, BKKBN's organization has been cited as a model of government-sponsored fertility control in a developing country (World Bank, 1990; Warwick, 1986; Snodgrass, 1979). Established in 1970, BKKBN developed a flexible family planning program that coordinates the activities of several ministries, local governments and volunteers. Despite the faltering economy of the late 1980s and dramatic reductions in the Health Ministry's budget, the BKKBN program budget continued to expand at a steady rate throughout the decade (World Bank, 1990). Moreover, manipulation of contraceptive procurements has increasingly become a key instrument in BKKBN’s array of interventions.

BKKBN’s main methods of encouraging contraceptive use are through contraceptive subsidies and improving distribution networks. BKKBN purchases and directly distributes contraceptives principally through the Ministry of Health's clinic system and through local community-based village contraceptive distribution centers

(VCDCs). BKKBN also promotes contraceptive demand and encourages women to postpone marriage through information, education and communication (IE&C) activities. Most recently, BKKBN family planning field workers have taken on an expanded role, promoting income generating groups, and managing group-based small savings and loan facilities.

Indicative of the endogeneity of program placement discussed above, BKKBN's activities have neither been introduced uniformly nor randomly in Indonesia, rather they have been tailored to local needs (Snodgrass, 1979; BKKBN, 1984). Provincial and District officials are given substantial incentives to increase contraceptive prevalence and are given autonomy to tailor family planning inputs to local needs and conditions. These officials negotiate method-specific prevalence targets and are provided resources based on these negotiated targets and their prior record of target achievement.

2. DATA

We make use of data from multiple sources, capturing fertility and its determinants for almost a decade across Indonesia's 27 diverse provinces. We use multiple Demographic and Health Surveys, disaggregated statistics on family planning program activities, and national labor-force and employment surveys to track fertility and its determinants. The unit of observation in our data is the district. We have quarterly data on 286 districts for 9 years. Therefore, we have 10,296 observations. Descriptive statistics are provided in Table 1.

The Indonesia Demographic and Health Surveys (1991 and 1994) provide historical data on respondents' fertility, marriage, and contraceptive use, as well as age and education. The quality of DHS retrospective birth history data is well documented as highly accurate (CBS, 1989). The 1991 DHS surveyed a nationally representative sample of 23,000 women from 1,100 sampling units; the 1994 DHS surveyed 28,000 women from 1,200 sampling units. Within sample units we aggregate data from individual women (about 20 women per sample point) to produce district-level measures of fertility, several of its proximate-determinants, the age distribution, and educational attainment.

Measures of fertility and its proximate determinants have been constructed and are presented over the sample period in Figure 1 below. This shows the stable but declining marriage rates (associated with continued increases in the age at marriage), along with the gradual increase in contraceptive prevalence. By contrast, the two measures of fertility, the overall hazard (births per person-year), and the birth rate among married, non-contracepting women, while declining over the period, are much more erratic than the more stable proximate determinants.

Our data on family planning services, personnel and infrastructure are from a wealth of program reporting statistics available in Indonesia. Since 1982, computerized monthly records of the numbers of family planning clinics, summaries of monthly activities, and detailed statistics on the numbers and types of subsidized contraceptives distributed have been maintained. The strength of BKKBN's programs can be measured using their monthly records of family planning activities within each district in Indonesia. The data allow construction of measures of specific aspects of the Indonesian family planning program.

We capture family planning program inputs in three different variables, all of them measured at the district level, per thousand population of eligible married couples (ELCO). These variables are:

- the government expenditures (1996 Rupiah) per ELCO on contraceptive supplies in a district;
- the number of Ministry of Health clinics per 1000 ELCO that distribute contraceptives in a district; and
- the number of village contraceptive distribution centers per 1000 ELCO in a district.

The latter two variables experienced substantial increases over the period. But the real value of per capita contraceptive expenditures peaked around 1988, and then declined through the period studied in this paper. However, these subsidies grew rapidly again up to the 1997/98 monetary crisis. Thus, while contraceptive subsidies declined in importance over the period of this study, they continue to be an important policy instrument for BKKBN.

We measure the economic status of the family in terms of the wages that the husband and wife command in the formal wage sectors. We calculate male and female hourly wages from the 1986 through 1994 SAKERNAS surveys. The SAKERNAS surveys are nationally representative enumerations of 50,000 to 60,000 households. Wages earned by all "employees", i.e., those not self employed, and hours worked by the same persons were the source of data. The wages were predicted from regressions of individual real hourly wages on individual ages and levels of education. Unique intercepts were estimated for each district, but age and education coefficients were constrained to be equal across all districts within a province. These regressions were run separately for males and females, urban and rural populations, provinces, as well as by year.

In sum, these data provide an eight-year history of fertility, contraceptive use, and economic development, alongside the expansion of the family planning program inputs, at a nationally- representative level. The length of the time frame allows us to document the joint roles of family planning programs and socioeconomic development in

influencing Indonesia's fertility decline. The interesting time-series changes in fertility, contraception, economic conditions and government programs provide important sources of variation in key factors influencing demographic behavior.

3. THE ALLOCATION OF FAMILY PLANNING INPUTS

In Indonesia, family planning program inputs are allocated at three administrative levels:

a) BKKBN central allocates its budget by category across the 27 provinces;

b) Each province allocates its budget by category across its districts (300 nationally);

c) Each district allocates its budget by category to delivery units that exist at the sub-district level and lower (4,000 sub-districts).

At each level the lower administrative units negotiate with the higher administrative unit over their annual budget allocations.

These allocation decisions make use of routinely reported information from an annual planning and logistics system. In the beginning of a fiscal year, officials in each of Indonesia's 4,000 sub-districts are asked to estimate their method-specific contraceptive requirements for the coming year. These estimates are based on past contraceptive use and the forecasted number of eligible couples (ELCOs). The estimates are reported to their district offices. The district offices, in turn, compile the sub-district requests along with other district information to generate a set of district demand projections. These district estimates are forwarded to the 27 provincial offices, which aggregate them and report provincial-level estimates to the national office. At the national level, BKKBN compiles the provincial requests and compares them to the forecasts of demand from their demographic models. Based on the provincial requests, the available resources, and input from the demographic models, BKKBN modifies the provincial requests, and proposes a draft set of provincial allocations. National and provincial planning officers then negotiate a revised set of allocations. The revised allocations are then presented to the National Development Planning Body, who then negotiates another set revisions to the allocations and an associated budget with BKKBN. The final provisional allocations are submitted for approval to the President and Parliament as part of the national budget.

In practice, district, provincial and central BKKBN planners establish population growth, fertility and contraceptive use projections based on projections of the number of eligible couples, past records of contraceptive

use, shortages or excess stocks, and other location-specific information. At the national level this information is used to negotiate the allocation of the central budget across the competing demands of the 27 provinces. At the province level, this same information is used to negotiate the allocation of the province's budget across the competing district demands, and at the district level, across the sub districts and programs.

This process determines the annual targeted allocations at the beginning of the budget year and the fixed budgets allocated to the Provinces. However, the allocations from the Provinces to districts and in turn from the districts to sub-districts allow for real-time reallocations based on shortages or excess stocks in the field. Contraceptive supplies are shipped on a monthly basis. If one area experiences a shortage, then the provincial or district BKKBN office can reallocate from another areas' future shipments to the shortage area.

This discussion suggests a model of family planning program input allocation across geographic areas. At the beginning of the year the central government allocates a budget to BKKBN based, in part, on forecasted contraceptive demand built up from a sophisticated grassroots information system. Once BKKBN has its annual budget, the 27 provinces compete for annual allocations. If one province is allocated more, then less is available to be allocated to the other provinces. A provincial allocation, then, is a function of its forecasted contraceptive demand, the forecasted contraceptive demands of competing provinces, and the national budget constraint. The districts, similarly, compete with one another for their budgets from the Province. Initial district budgets are similarly functions of its forecasted contraceptive demand, the forecasted contraceptive demands of competing districts, and the provincial budget constraint. However, a district's actual budget is modified based on its own and competing districts' shortages and surpluses. Therefore a district's allocations are a function of both its and its competitors' real and forecasted demand as well as the provincial budget constraint.

Therefore, we specify a model of the provincial allocation of family planning expenditures to a district as:

$$E_{it} = a_i + b_1\hat{C}_{it} + b_2\sum_{j\neq i}\hat{C}_{jt} + b_3\left(C_{it} - \hat{C}_{it}\right) + b_4\left(\sum_{j\neq i}C_{jt} - \sum_{j\neq i}\hat{C}_{jt}\right) + gE_t + t_{it} \qquad (1)$$

Where: E_{it} is the budget allocated to district i in period t,

$\hat{C}_{it}$ is the forecasted contraceptive demand in district i in period t, and

E_t is the provincial budget in period t.

Equation (1) says that a district budget allocation is a fixed amount which is adjusted based on the district's forecasted contraceptive use, the forecasted contraceptive use of competing districts, the difference between actual and forecasted contraceptive use in the district (i.e. shortage or surplus), the difference between actual and forecasted contraceptive use in the competing districts, the provincial budget constraint, and an error term.

If the government uses a simpler allocation rule based on fixed characteristics, then the district allocation would just depend on the fixed effect and the provincial budget, and the b's will be zero. In this case, the fixed effects would control for the endogeneity of program placement. However, if the government allocations respond to current and lagged contraceptive use information, then these b coefficients would be non-zero, and the allocations will be correlated with the non-fixed unobservables in the fertility equation. If this is true, a fixed effects model will not control for the endogeneity of program placement. The above model tests which approach is appropriate for estimating program impacts.

The dependent variable is the natural log of the quarterly district contraceptive procurement expenditures per ELCO. The independent variables are the forecasted number of ELCOs in the district and in competing districts, past contraceptive use in the district and in competing districts, and the provincial budget per ELCO. The number of ELCOs and past contraceptive use are proxies for forecasted contraceptive demand. The higher forecasted demand, the higher the allocation. However, BKKBN targets subsidies to low prevalence areas, so we expect an overall negative effect of own lagged contraceptive prevalence and a positive effect of lagged prevalence in competing districts. Similarly, the number of ELCOs in the district should have a positive effect and the number of ELCOs in competing districts should have a negative effect on budget allocations. The difference between current contraceptive prevalence and forecasted demand is the shortage/surplus. Therefore, we expect own prevalence to be positively and competing prevalence to be negatively related to budget allocations.

The model was estimated using district and quarter fixed effects and the results are presented in Table 2. The results reject the hypothesis that the allocations are made based only on fixed factors subject to an overall budget constraint. Information on current contraceptive use and population changes affects the allocations, which suggeststhat the government dynamically allocates contraceptive subsidies in response to changes in contraceptive prevalence. In this case subsidies respond positively, in the short-run, to contraceptive prevalence surprises. This is consistent with BKKBN's practice of reallocating monthly allotments from districts with excess stocks of

contraceptives to districts that can absorb them. How BKKBN responds in the long run is more strategic; regions with little need for support are to be gradually weaned of their subsidies, while poor performing areas are brought under more careful scrutiny and perhaps provided new and additional inputs. Thus, according to BKKBN strategy, the long-term response should differ from the short-term. Indeed, the very long-term response determines the correlation between the district fixed effects (i.e., average CPR) and contraceptive subsidies – a correlation that is overwhelmingly [Positve. These results imply that a fixed effects model will not sufficiently control for the endogeneity of program placement in models that measure the effect of family planning programs on fertility.

This analysis also suggests a set of valid instruments. Recall that a valid instrument is one that is correlated with the program inputs, but uncorrelated with the error term in the fertility equation. In other words, a valid instrument is a right hand side variable in the program input equations, but not in the fertility equation. The model developed in this section implies that variables that shift contraceptive demand in competing districts affect the allocation of contraceptive subsidies to other districts, but do not directly affect fertility. Therefore, we use current and lagged male and female wage rates, and the age and education distribution of ELCOs in competing districts as instruments.

4. THE IMPACT OF FAMILY PLANNING PROGRAM INPUTS

Our primary goal is to evaluate the contribution of government family planning program inputs to fertility decline in Indonesia. Our conceptual framework is illustrated in Figure 2, which depicts the relationships among fertility, its proximate-determinants, and exogenous factors. According to the proximate-determinants model, four factors are the most important determinants of fertility: marriage, contraceptive use, postpartum amenorrhea, and use of induced abortion (Bongaarts and Potter, 1993).

The four proximate-determinants are choice variables that are determined by observed and unobserved exogenous factors. Observable individual and household characteristics that affect the proximate-determinants include age, education, and income. Community-level variables such as prices, wages, infrastructure and the availability of contraceptive information and supplies also affect the choice variables. In addition to observable factors, unobservable determinants such as a woman's underlying preferences and her fecundity (the biological ability to conceive and bear children) also play a role in determining fertility outcomes.

We model the demand for children by regressing fertility directly on the exogenous factors. The results of such an analysis reveal the net impact of the exogenous variables on fertility (as well as their relative importance), but do not identify the mechanisms through which they work. The conceptual framework in Figure 2 illustrates the standard relationships among fertility, its proximate determinants, and exogenous factors. These factors influence fertility through the mediating influence of the proximate determinants. We will regress fertility directly against these determinants. The parameters implied by this relationship reflect the net impacts of programmatic, household and individual characteristics, through all of the proximate determinants, on fertility. In this specification, the mechanisms through which these factors influence fertility are not explicitly modeled. This summarizing specification is the reduced-form model.

Estimation of the reduced form is complicated by the fact that BKKBN introduced program inputs in a dynamic, non-random fashion. This implies that program inputs are correlated with both observed and unobserved determinants of fertility. Consequently, the inputs may be correlated with the error terms in the reduced form model, rendering both OLS and fixed effects coefficient estimates inconsistent. Instead, we use an instrumental variable, fixed-effects method to control for this endogeneity. The specific set of instruments was discussed in the previous section.

Due to the need to specify a fixed-effects model of fertility and its proximate determinants, the subsequent analyses are conducted at the community level. The demographic data – birth probabilities, age distributions and educational attainment – were aggregated to the district level from an average of four enumeration areas (EAs) per district, each composed of roughly 30 households per EA. Government program inputs, and wage data are also measured at the district level.

The dependent variable is the community-level quarterly birth hazard. It is calculated as proportion of women aged 15-49 who gave birth in an enumeration area over a three-month period. Quarterly birth hazards were measured nine months early at the approximate date of conception to facilitate the match between births and the factors influencing conceptions. Although observations on births, contraception and marriage provide 34 quarterly intervals starting from the first quarter in 1986 through the second quarter in 1994, fewer observations can be used for the analyses; the first three quarterly birth hazards do not match up with measured influencing factors. This leaves

us with 31 quarterly intervals, starting with births resulting from conceptions occurring in the third quarter in 1986 through the third quarter in 1993.

Exogenous variables are selected based on the standard model of demand and supply of births as depicted in Figure 2. Because we use a fixed-effects estimator, only time-varying variables are included. These include the age distribution, to account for changes in fecundity associated with aging; women's' economic opportunities, reflected by their educational attainment and mean real wages; household economic resources and the value of time captured by male and female real wages; and measures of family planning programmatic inputs.

The individual age and education data from the DHS data were aggregated to district proportions. From Table 1 we can see that there were roughly 10 percent increases in the proportion aged 25-34, and comparable declines in the proportion aged 40-49. The remaining changes were all much smaller. The changes in educational attainment of women aged 15-49 reflect dramatic shifts in primary school enrollment over the past several decades. As new cohorts enter our analysis and old cohorts leave, we see substantial shifts in educational attainment. These effects can be seen in Table 1, where the proportion with no education declines by 20 percent over the period, and the proportion with completed primary education increases similarly.

Mean levels of male and female wages are reported in Table 1. Female real hourly wages increased by 17 percent over the analysis period; similarly male wages increased by 19 percent. The wage growth was not uniform throughout Indonesia. Due to regional differences in economic growth, caused by localized impacts of oil shocks, regional growth of industries and other export growth, important differences in the rates of wage growth exist across the major regions of Indonesia.

The family planning program inputs are captured in quarterly district contraceptive procurement expenditures per ELCO (materials only), clinics per ELCO in the district, and VCDCs per ELCO in the district. We treat all three of these variables as endogenous and use the set of instruments described in the previous section to control for their endogeniety.

The regression results are reported in Table 3. The specifications are all linear probability models so that coefficients are interrelated directly as impacts on the birth hazard. The model was estimated using several different procedures; the first column reports the results using OLS, the second using district fixed effects and time fixed effects (FE); and the fourth using instrumental variables and district and time fixed effects (IVFE). For the IVFE

model, the three first stage regressions for contraceptive subsidies, clinics and VCDCs demonstrate that the instruments have sufficient power for identification. Most of the identifying variables are significant in each of the regressions. The F-statistics are 73.32, 68.46, and 20.19, respectively. And the R-squares are 0.38, 0.37, and 0.14 respectively.[4]

The results on the non-family planning variables are consistent with expectations. More educated women have fewer births. The birth hazard first rises with age and then falls. Female wages are weakly negatively correlated and male wages are weakly positively correlated with fertility.

The first three rows of Table 3 report the estimated coefficient on the family planning program variables: contraceptive subsidies, VCDCs and clinics. Only the IVFE model has consistently negative signs on all three coefficients. While the coefficients are not individually significant from zero, they are jointly strongly significant. The F-statistic for the joint significance of the 3 coefficients is 12.31. Moreover in specifications not reported here, any two of these three variables are each significantly negative. This suggests that there is substantial collinearity between the three policy variables, and we do not have large enough sample sizes to differentiate between them. However, our results do suggest that the three family planning program inputs, working together, significantly reduced fertility; but from this evidence alone, we cannot evaluate their relative importance.

It is interesting to note that using the IVFE estimation method moves the point estimates in the "right" direction. The coefficient on contraceptive subsidies is positive and significantly different from zero in the OLS and FE models, fixed effects lowers the magnitude of the coefficient by two-thirds, and the IVFE model pushes the coefficient negative albeit not significantly different from zero. The coefficient on VCDCs is negative in the OLS model, but triples in size in the IVFE model, suggesting that these significant OLS and FE estimates could actually *underestimate* the true effects. The coefficient on clinics is positive and significant in the OLS model, essentially zero in the FE model, and negative but not significant in the IVFE model.

The other coefficient estimates are consistent with expectations. As the age distribution of women grows older, fertility falls and more education is associated with lower fertility. These factors explain much of the fertility

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[4] F-statistics close to 1.0 are a cause for concern that IV coefficients are subject to a finite sample bias, even with arbitrarily large sample sizes (Bound, Jaeger and Baker, 1995), but F-statistics as large as these indicate this is not a problem.

decline in Indonesia, where the population is aging and younger cohorts are better educated. These results are consistent with early work (Gertler and Molynueax, 1994).

While the IVFE fertility model allows the intuitively appealing interpretation that family planning programs matter – the program variables are all negative and jointly significant – we are concerned that the individual program effects are too imprecisely measured to be of much use. In particular, since roughly 50% of BKKBN's budget is typically allocated to procuring and distributing contraceptives, we would like to be able to estimate how these allocations affect fertility, and how these effects compare to the effects of the other inputs. But the precision is simply lacking. The critical question is whether the coefficients on the policy variables are really zero or are that small, but imprecisely measured. [AWK?]

To answer this question we turn to the proximate determinants model to draw fertility impact inferences from program impacts on contraceptive prevalence. While these programs impact the other proximate determinants as well, contraception remains the principal factor determining Indonesian fertility. So we examine the effect of these program inputs on contraceptive use, using the same statistical methods. Since there is a higher signal to noise ratio in contraceptive use than in fertility,[5] we get more power with the same sample sizes, and are able to say much more about the absolute and relative magnitudes of program impacts.

The results of the contraceptive use models are presented in Table 4. Similar to the fertility models, OLS and FE produce results inconsistent with expectations. However, the coefficient on contraceptive subsidies, which was negative in the OLS and FE regressions, becomes positive and significant in the IVFE model. The coefficient's point estimate (0.045) implies that the reduction of total contraceptive subsidies by their mean annual level would reduce contraceptive prevalence by 5.6%. To infer a potential effect on fertility, we assume that fertility of contraceptors is

[5] The "noise" in the birth hazard equations are due partly to sampling error, but mostly to non-sampling error – particularly those due to temporal shocks. Based on DHS estimates of TFR sampling errors (2% of the three-year TFR), the sampling standard error is about 7% of the quarterly birth hazard (CBS, 1998.) But as can be seen in Figure 1, the magnitude of annual temporal shocks can be far larger. By contrast, contraceptive prevalence rates appear as almost a straight line in the same figure.

zero, and that fecundity of non-contraceptors is unchanged, i.e., it is not influenced by the changes in contraceptive use. Under these conservative (though generally untested[6]) assumptions, the implied effect on fertility is about 6%.

This effect is larger but close to the point estimate from the fertility models. The fertility models imply that contraceptive subsidies reduce fertility by about 3 percent. The 95 percent confidence region for the estimate from the contraceptive use model includes 3 percent. This implies that the estimated effect of contraceptive subsidies on fertility based on the contraceptive use model is not significantly different from the point estimate implied by the fertility model. In fact, it suggests that contraceptive subsidies have a small but significant effect on fertility.

While the estimated effect of clinics on contraceptive use is negative and significant in the OLS and FE models, it is positive and significant in the IVFE model. The order of magnitude suggests that going from zero to mean clinic availability increases contraceptive use by about 21 percent and under conservative assumptions reduces fertility by about 21 percent. This is about half the point estimate of the estimated impact of clinics from the fertility model. However, the 95 percent confidence region for the estimated impact based on the contraceptive use model includes the point estimate (42 percent) derived from the fertility model. These results suggest that the availability of family planning clinics has a significant effect on reducing fertility.

The estimated impact of VCDCs on contraceptive use is small and not significantly different from zero in the IVFE model. This suggests that VCDCs did not contribute much to fertility reduction in Indonesia over the sample period.

The estimated coefficients of the other variables in the contraceptive use model are consistent with expectations and with the estimates from the fertility models. Both population aging and expanded educational attainment of women are associated with increased contraceptive use.

5. POLICY IMPLICATIONS

The analyses above suggest that the impacts of government contraceptive procurements on contraceptive use, and by extension on fertility, are relatively small. Given that contraceptive procurements are Indonesia's single

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[6] Gertler and Molyneaux (1994) measured significant program effects on the fertility of unprotected women. These suggested that factors associated with increased contraceptive use also increased the fecundity of non-

largest family planning expenditure item, these results are especially important for Indonesian policy-makers, as there are probably other, more productive uses for these government resources. These alternative uses may include demand promotion activities. They certainly also include promoting secondary education for women. Indeed, our results suggest that the schooling effects are much larger than the family planning program effects.

While contraceptive subsidies could be more effective in a different setting, it may be instructive for policy-makers outside of Indonesia to understand why contraceptive procurement budgets have remained consistently high, despite their relatively small impact. BKKBN's rationale for continued contraceptive subsidies has been to assure the poor of affordable contraceptives. However, DHS data from 1991 through 1997 indicates that the effectiveness of BKKBN's targeting of subsidized contraceptives to poor households has actually diminished in recent years, particularly after the period of this analysis. The upper panel of Figure 3 displays the prices households paid for contraceptives (and related services) prior to the 1991, 1994 and 1997 DHS surveys. Overall, real contraceptive prices increased by more than 80% over the period. However, for the poorest 40% of the population, contraceptive prices increased by nearly 160%. This more rapid growth of prices faced by the poor would suggest that the effectiveness of contraceptive subsidies in the more recent years is probably even lower than those measured here.

The silver lining to BKKBN's contraceptive pricing cloud is that despite the more rapid increase in contraceptive prices for the poor, contraceptive prevalence of the poor has continued to converge on that of the non-poor. This suggests that the growth in household demand for contraceptives, particularly among the poor, has more than compensated for the increased prices they face. Perhaps BKKBN's demand promotion efforts (unmeasured in these analyses) have had their desired effects; or perhaps the broader impacts of development have more than compensated. However, whatever the cause of the growing demand, it is clear that contraceptive subsidies are not a major factor, even though they continue to be BKKN's major cost item.

What are the implications for other family planning programs? We caution against asserting that contraceptive subsidies do not matter elsewhere. In Indonesia in 1996, the annual unsubsidized cost of an injectable contraceptive was about Rp.18,300. In the same year, annual household expenditures for a family of four living at the rural poverty line were Rp. 1,315,000. This implies that even the most expensive privately provided contraceptive

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contracepting women, but not by much.

method cost only 1.5% of a poor household's total budget. (Privately provided pills cost about the same, and privately provided IUDs cost about one third that.) By contrast, Bulatao (1998) reports that in many African countries, household costs for contraceptive pills constitute five percent of *average* household expenditures. For six of these countries, they would constitute 20 percent. Because of these differences, we do not extrapolate our results to countries where contraceptive costs are a much higher portion of household expenditures.

6. CONCLUSIONS

In this paper, we investigated the effects of public family planning programs on fertility in Indonesia, controlling for economic growth and improvements in the status of women. We overcame one of the major stumbling blocks to measuring the impacts of family planning programs on fertility—i.e. that family planning programs are not randomly placed. We did so by explicitly modeling the way in which the government allocates these resources.

We found that the government indeed targets resources to areas of low contraceptive use and dynamically updates those allocations based on performance. This process implies that the usual method of controlling for the non-random placement of programs, a fixed effects model, produces inconsistent estimates of the impact of family planning programs on fertility. The model did, however, suggest a feasible instrumental variables procedure for getting consistent estimates. Because provincial governments have to allocate resources across districts subject to an overall budget constraint, an increase in the allocation to one district reduces the amount that can be allocated to other districts. Therefore, variables that shift contraceptive demand in competing districts are valid instruments.

The empirical work confirmed that both OLS and fixed effects estimates give biased and misleading results. Only the instrumented models provided results consistent with theory. Our results suggest that contraceptive subsides in Indonesia lower fertility by about 3-6 percent and that expanding the distribution network by one standard deviation lowers fertility by about 12 percent.

These results have two important policy implications. While contraceptive subsidies do appear to reduce fertility, the magnitude of the effect is quite small. This calls into question Indonesian's decisions to allocate half of its family planning budget to contraceptive subsidies. On the other hand, the expansion of the distribution network in rural areas did have a significant effect on fertility.

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Table 1. Descriptive Statistics (N=10,296)

	85/6	86/7	87/8	88/9	89/0	90/1	91/2	92/3	93/4	Total Mean	Std. Dev.
Quarterly Birth Hazard	0.094	0.114	0.11	0.166	0.106	0.076	0.078	0.095	0.076	0.101	0.519
Contraceptive Prevalence	0.365	0.38	0.405	0.428	0.443	0.464	0.48	0.496	0.516	0.453	0.928
Predicted ELCOs	156208.5	158184	161208.4	164291.2	166668.8	169985.2	173156.6	176624.3	179892.9	168831.6	737927.3
Contraceptive Subsidy/ELCO	431.015	634.687	816.86	796.639	510.522	527.792	512.46	537.006	516.716	630.35	1870.627
VCDCs/10,000 ELCO	0.332	0.345	0.355	0.38	0.38	0.409	0.435	0.452	0.477	0.401	0.333
Clinics/10,000 ELCO	2.889	3.035	3.266	3.506	3.714	3.909	3.687	3.390	3.162	3.331	2.690
Prop. No Educ.	0.187	0.182	0.174	0.165	0.157	0.151	0.144	0.137	0.132	0.155	0.836
Prop. <Prim Educ.	0.327	0.322	0.315	0.306	0.298	0.292	0.284	0.275	0.269	0.295	0.721
Prop. Prim School	0.236	0.24	0.244	0.25	0.256	0.259	0.265	0.27	0.272	0.257	0.669
Prop. <Hi School	0.106	0.11	0.118	0.128	0.133	0.144	0.143	0.151	0.166	0.137	0.47
Prop. w/Hi School+	0.144	0.147	0.149	0.151	0.155	0.154	0.163	0.167	0.16	0.156	0.843
Prop. w/Hi School+	0.144	0.147	0.149	0.151	0.155	0.154	0.163	0.167	0.16	0.156	0.843
Prop. Aged 15-19	0.235	0.228	0.229	0.23	0.222	0.217	0.211	0.208	0.206	0.219	
Prop. Aged 20-24	0.223	0.217	0.209	0.201	0.199	0.19	0.184	0.184	0.18	0.195	0.269
Prop. Aged 25-29	0.184	0.18	0.179	0.183	0.185	0.183	0.185	0.178	0.171	0.181	0.258
Prop. Aged 30-34	0.15	0.153	0.15	0.148	0.153	0.153	0.156	0.159	0.157	0.154	0.23
Prop. Aged 35-39	0.108	0.107	0.111	0.114	0.118	0.121	0.125	0.127	0.127	0.119	0.203
Prop. Aged 40-44	0.1	0.112	0.1	0.089	0.093	0.09	0.09	0.093	0.095	0.094	0.208
Prop. Aged 45-49	0	0.003	0.022	0.035	0.03	0.046	0.049	0.051	0.064	0.038	0.189
Pred. Male Hrly.Wage (1986 Rp.)	6.385	6.383	6.37	6.36	6.397	6.457	6.492	6.497	6.564	6.44	1.368
Pred. Fem. Hrly.Wage (1986 Rp.)	5.943	5.935	5.908	5.913	5.945	5.994	6.039	6.056	6.112	5.987	2.07

Table 2: Fixed Effects Model of Family Planning Contraceptive Subsidy Allocation

Independent Variable	Ln(Subsidy/ELCO)
District Population	0.037 (1.05)
Lagged District Contraceptive Prevalence	-0.037 (0.90)
Current District Contraceptive Prevalence	0.104 (2.55)
Average Population of Competing Districts	-0.008 (3.64)
Average Lagged Contraceptive Prevalence of Competing Districts	0.549 (3.73)
Average Current Contraceptive Prevalence of Competing Districts	-0.312 (2.24)
Ln(Provincial Budget)	0.001 (95.57)
District Fixed Effects	Yes
Quarter Fixed Effects	Yes
R-Squared	0.77

Table 3: Fertility Models
Dependent Variable = District Birth Probability Per Quarter
(t-ratios in parentheses)

Independent Variable		OLS	Fixed Effects	IV-FE
Contraceptive Subsidies Per ELCO	(Rp. 000's)	.028	.010	-.005
		(7.17)	(1.64)	(0.20)
VCDCs Per 1000 ELCO		-.002	-.001	-.006
		(4.69)	(0.48)	(1.37)
Clinics Per 1000 ELCO		.009	-.001	-.042
		(1.93)	(0.48)	(1.16)
Proportion Some Primary School		.008	-.043	-.052
		(0.57)	(1.28)	(1.54)
Proportion No School		---	---	---
Proportion Completed Primary School		-.057	.002	.004
		(4.64)	(0.05)	(0.12)
Proportion Completed Some Secondary School		-.030	-.040	-.044
		(1.63)	(1.02)	(1.00)
Proportion Completed Secondary School		-.065	-.104	-.095
		(4.49)	(3.18)	(2.84)
Proportion Age 15-19		---	---	---
Proportion Age 20-24		.037	.082	.087
		(1.15)	(2.13)	(2.25)
Proportion Age 25-29		.036	.032	.029
		(1.18)	(0.76)	(0.67)
Proportion Age 30-34		-.011	.085	.081
		(0.34)	(2.08)	(1.92)
Proportion Age 35-39		-.189	-.004	.001
		(5.16)	(0.08)	(0.01)
Proportion Age 40-44		-.258	-.150	-.147
		(7.32)	(2.97)	(2.88)
Proportion Age 45-50		-.299	-.227	-.243
		(7.10)	(3.22)	(3.39)
Log Male Wage		-.002	.009	.0009
		(0.31)	(0.98)	(0.95)
Log Female Wage		.005	-.006	-.004
		(1.01)	(0.90)	(0.71)
Time Fixed Effects		No	Yes	Yes
District Fixed Effects		No	Yes	Yes
R-Squared		0.06	0.23	----

Table 4: Contraceptive Use Models
Dependent Variable = District Contraceptive Prevalence per Quarter

	OLS	Fixed Effects	IV-FE
Contraceptive Subsidies Per ELCO (Rp.*1,000)	-.100	-.017	.045
	(18.79)	(4.41)	(2.56)
VCDCs Per 1000 ELCO	.006	.002	.002
	(8.46)	(2.35)	(0.71)
Clinics Per 1000 ELCO	-.045	-.003	.099
	(7.30)	(0.29)	(4.05)
Proportion No School	---	---	---
Proportion Some Primary School	.217	.070	.086
	(10.88)	(3.22)	(3.74)
Proportion Completed Primary School	.443	.135	.147
	(26.71)	(6.68)	(6.86)
Proportion Some Secondary School	.417	.261	.277
	(16.91)	(9.91)	(10.07)
Proportion Completed Secondary School	.336	.309	.297
	(18.75)	(12.42)	(13.18)
Proportion Age 15-19	---	---	---
Proportion Age 20-24	.268	-.115	-.121
	(6.19)	(4.53)	(4.60)
Proportion Age 25-29	.232	.055	.082
	(5.55)	(2.00)	(2.81)
Proportion Age 30-34	.617	.215	.232
	(14.57)	(7.93)	(8.12)
Proportion Age 35-39	.803	.039	.047
	(16.21)	(1.17)	(1.37)
Proportion Age 40-44	.538	.026	.014
	(11.03)	(0.80)	(0.40)
Proportion Age 45-49	.601	-.130	-.107
	(10.75)	(2.81)	(2.22)
Log Male Wage	-.085	.002	-.002
	(9.47)	(0.34)	(0.39)
Log Female Wage	-.039	.023	.022
	(5.78)	(5.74)	(5.09)
Time Fixed Effects	No	Yes	Yes
District Fixed Effects	No	Yes	Yes
R-Squared	.32	.35	---

Table 5. Mean Contraceptive Prices and Prevalence, by Method and Year

Method	Contraceptive "Price"[+] (Rp.1,000/year)			Prevalence		
				%		
Full Population	1991	1994	1997	1991	1994	1997
Pill	4.34	5.66	7.67	14.7	17.1	15.4
IUD	1.02	1.36	1.47	13.3	10.2	8.1
Injectable	9.32	10.75	11.34	11.7	15.2	21.1
Implant	0.48	0.57	0.70	3.1	4.9	5.9
Others	6.44	8.72	12.02	6.8	4.2	3.7
Total	4.04	5.85	7.36	49.6	51.5	54.2
Poorest 40%						
Pill	2.62	4.47	6.92	12.7	15.0	14.5
IUD	0.12	0.22	1.06	14.7	10.8	6.6
Injectable	8.45	9.43	11.06	8.7	12.3	19.7
Implant	0.33	0.50	0.61	3.0	5.2	6.2
Others	2.37	2.74	8.12	2.4	3.2	2.7
Total	2.78	4.23	7.07	41.6	46.4	49.8

[+] Price is defined as annualized household contraceptive expenditures in constant 1991 Rupiah (in 1991, Rp.1,000 equaled approximately $0.50).

Source: 1991, 1994 and 1997 Demographic and Health Survey Data, supplemented with 1992, 1995 and 1998 SUSENAS-based estimates of per-capita household expenditures.

Figure 1. Proximate Determinants and Fertility

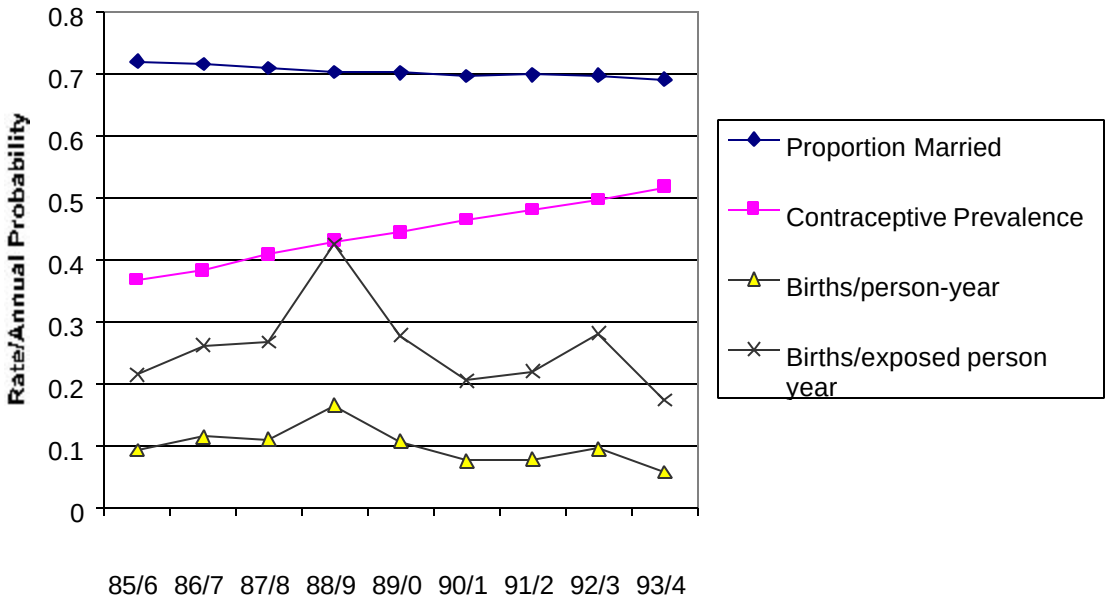

Figure2: Conceptual Framework

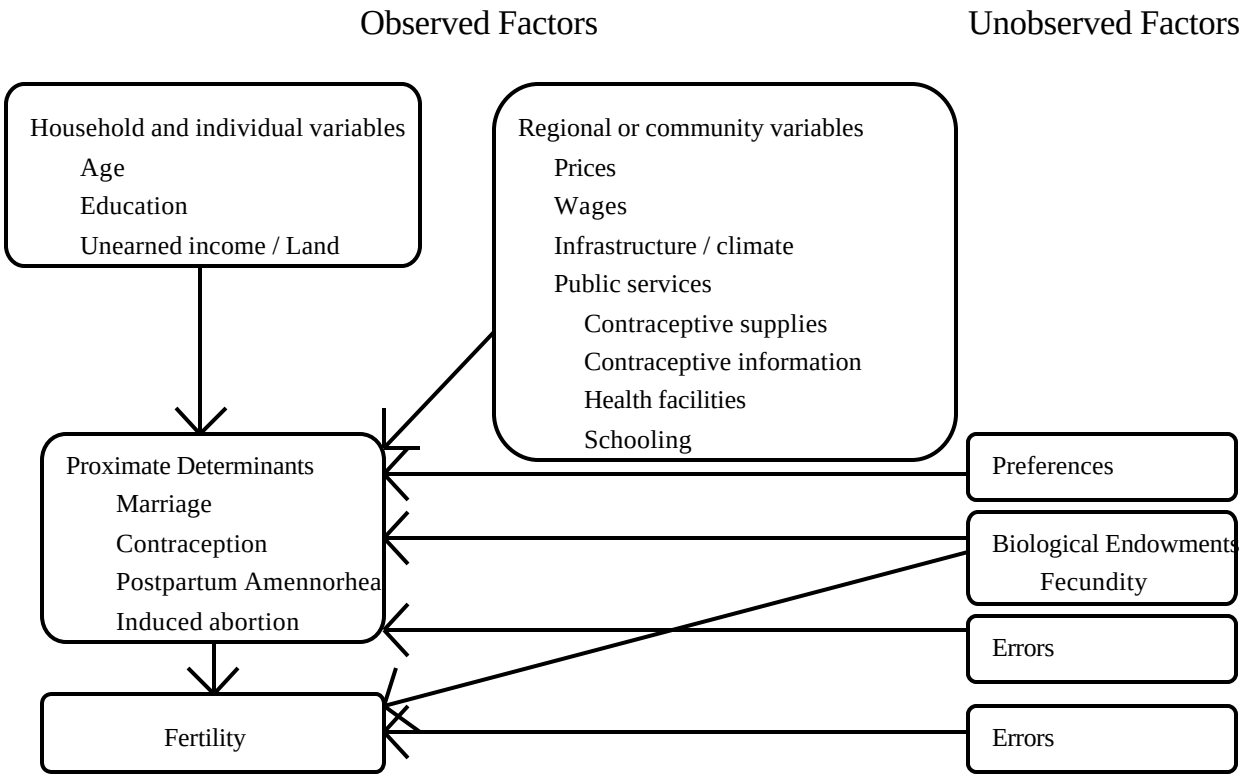

Figure 3. Contraceptive Price and Prevalence Trends: All Eligible Couples, and the Poorest 40%