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Abstract
This paper analyzes the accuracy of the United Nations' population projections since the late 1950ies for six Southeast Asian countries: Indonesia, Malaysia, Singapore, Philippines, Thailand and Viet Nam. The study uses available projected and estimated age-structured data as well as published assumptions on fertility and mortality trends. A decomposition of the total projection errors into base errors (wrong estimates of demographic conditions at the beginning of projection interval) and change errors (wrong assumptions about the trends) shows that the base errors have generally been decreasing over time presumably as a consequence of improving demographic monitoring systems. The change errors, on the other hand, do not decline over time. This seems to be due to a number of country specific cultural and political factors whose effect was not anticipated well as to a lack of good theories with predictive power. These findings suggest the need to give more explicit attention to the treatment of uncertainty in future population projections.

1. Introduction

Population projections are an important input to policy making at the local, regional, and national levels. They become part of policy formulation and the decision-making process, which is why the forecaster's principal aim should be to produce the most accurate forecasts possible. Since populations only change slowly, they are easier to project for several decades into the future than many other social phenomena. Furthermore, assumptions need to be made for only three components of change: future fertility, mortality and migration. Despite the fact, however, that there are not large numbers of variables to deal with, there still is considerable uncertainty about the future paths of each of these three components, just as there may be uncertainty about current demographic conditions at the time the projection is being made, both in terms of population size and structure, and in terms of current fertility and mortality levels. This study will try to shed some light on projection errors that have resulted from these uncertainties in past population projections.

For the users of population projections it is very important to have at least some rough understanding about the uncertainty around the numbers they are using for their specific planning tasks. It makes a big difference for many applications whether planners can count on secure trends that will take a certain path with high probability or whether they have to make provisions for the contingency that the trends turn out to be quite different. The emerging field of probabilistic population projections explicitly addresses the quantification of uncertainties in population forecasting (Lutz and Goldstein, 2004). Here we help to prepare the ground for this

work by studying in detail the performance of past population projections in six countries that recently experienced rapid fertility declines, albeit with different speed and showing quite different patterns of decline.

In our attempts to understand and evaluate the uncertainty associated with new forecasts, it is instructive to have a good understanding about the sources of error in past forecasts. For this purpose it is not sufficient to look at average errors in total population size. One also has to study the projection errors for specific age groups which matter for policy making, and understand how these errors resulted from incorrect assumptions about the evolution of fertility and mortality.

This study is based on the only consistent long term series of population projections for all countries in the world since the 1950s, that been carried out by the United Nations Population Division. We first discuss previous work on the analysis of projection errors, introduce some of the measures that will be used, and summarily describe our methodology. We then consider the early UN population projections published in the late 1950s – a time when fertility in Southeast Asia had not yet started to decline – with a projection horizon to 1980. Errors in the UN projections with base years 1975 and 1980 are analysed with reference to current UN projections, with the findings interpreted in a country specific context. The final section discusses some implications of these findings for the treatment of uncertainty in future projections.

2. Measurement of Projection Errors

Population projections can be affected by different kinds of errors. Here we distinguish between errors that have to do with the estimates of the starting conditions (base line errors) and estimates that have to do with assumptions about future trends (trend errors). But one can even be more specific in the classification of different sources error. Keilman (1990, 2001) distinguishes between the following sources of errors:

a) *Errors in projection input data*: the base-year population structure may be based on incorrect census coverage or age-sex misreporting or undercounting. During enumeration some people may be excluded as a result of “difficult to trace” or “refusal to interview” or persons were unintentionally omitted during data processing. All of these comprise coverage errors in the census.
b) *Incorrect specification of forecast parameters*: supposed life expectancy is expected to rise at the same rate observed in the last 20 years, but in reality will increase at twice that rate. This may also happen for other assumptions.
c) *Unexpected events*: such as the outbreak of war, the impact of HIV/AIDS or other epidemics, natural disaster such as floods, cyclones and famine, economic boom, and the urgency of skill migration, etc.
d) *Randomness in parameters*: stochastic fluctuations in the estimated number of births, deaths and migrants are not taken into account in projection methods. Fortunately, experience shows that such errors are found to be small in general.
e) *Inaccurate projection model specification*: if in any case one of the three components fertility, mortality and migration is omitted from the projection model, then there is the possibility of bearing a forecast error.

Although it can be difficult to distinguish in quantitative terms between the different sources of error listed in this detailed classification, it is quite easy and straightforward to quantify the extent to which incorrect estimates about the base line conditions contribute to the

error and to what extent incorrect assumptions about the trend were the source of error. As we will see in the discussion of Tables 1-7 below, sometimes these errors can go into different directions and partly compensate each other, while in other cases they go in the same direction and reinforce each other.

Although the UN has produced a consistent set of population projections by age and sex for the populations of its member countries since the 1950s, little systematic investigation has been carried out with regard to the accuracy of the past UN forecasts. Moreover, most of the studies that have been conducted focused on developed countries. Long's (1992) survey of 30 industrialized countries shows that only eight of them systematically studied forecast errors. Inoue and Yu (1979) investigated the errors in total population size of six rounds of UN projections, with base years from 1950-1970. They found a consistent overestimation of the projected growth rate in developing countries after 1960, which was largely explained by the rapid slowdown of population growth in China. They also concluded that errors in the base-year population and in the growth rate of the population immediately preceding the starting year were important determinants of errors in the projected population size of developing countries. Keyfitz (1981) analyzed 1,100 projections made during the period 1939-1968 for various countries. The results indicate that populations in slowly growing countries can be estimated more precisely than populations in countries which are growing faster. Keyfitz concludes, and Keilman (1990) agrees, that population forecasting becomes less reliable once it extends beyond a relatively short projection horizon of 10 to 20 years. Lutz (1991), on the other hand, argues that the horizon for reliable forecasts can be stretched as far as 30 to 40 years, but beyond this the increase of uncertainty over time accelerates. When Stoto (1983) compared population projections and the actual growth paths of these populations, he found that the high and low variants of these projections seemed to resemble a standard deviation confidence interval. Forecast errors furthermore appear to be age specific; relatively large forecast errors have been found in the 0-4 year age groups and for persons 75 years and over (Groenewold and Navaneetham, 1998). When Keilman (1998, 2001) examined the accuracy of the UN forecasts of the age structure and crude birth and death rates in seven major regions of the world (Africa, Asia, Europe, the former Soviet Union, Latin America, Northern America and Oceania), he found that although accuracy had improved over time, thanks in part to better quality data, there were some countries that consistently did less well in their forecasts than others, especially the largest ones, such as India and China and the USA.

The above studies provide useful indications about the accuracy of forecasts. They tell us something about the relationships between accuracy and the projection horizon, about heterogeneity in age-specific accuracy, and about the importance of errors resulting from incorrect estimates of the base-year population. They tell us very little, however, about the accuracy of projections in developing countries that have experienced quite significant demographic discontinuities over the past decades. Hence our focus in this paper on the Southeast Asian countries Indonesia, Malaysia, Singapore, Philippines, Thailand and Viet Nam. As will be discussed later, despite of their regional proximity these countries are quite distinct in terms of their specific demographic trends.

The data used for this study come from various UN publications (see Table 1; UN 1958, 1966, 1980, 1985, 1994, 2007). In our analysis we adhere as closely as possible to the terminology used by the UN which refers to an "estimate" as data referring to past or present conditions and to a "projection" as data referring to a future point in time. We consider the estimates published in the most recent 2006 assessment for the historical series up to 2000 as

final, and label them as "observed". We assume therefore that in the future no further revisions of the estimates for series up to 2000 will be necessary and the 2006 assessment accurately reflects the actual conditions in the past.

There are several possible indicators for measuring the errors of past projections. The selection of the appropriate measure of the accuracy is to a certain degree a matter of taste, and according to Ahlburg and Lutz (1998), it is necessary to justify the measure chosen as a function of the specific purpose of the analysis. In this case a relative measure such as the percentage error (PE) seems most appropriate to summarize the results of the comparisons between different countries and over time.

PE is defined as

$$\mathrm{PE} = \left(\frac{\text{projected} - \text{observed}}{\text{observed}} \right) \times 100$$

Thus, if PE = 0, the projection was perfect and there was no error. A positive value of PE indicates that the projection was too high, i.e. there was an overestimation; a negative value of PE indicates that the projection was too low, i.e. an underestimation. Unlike other possible measures that put more weight on small deviations (using a logarithmic scale) or on large deviations (using a quadratic scale), our chosen measure implies that the extent of deviation enters the analysis in an unweighted fashion.

We also calculate what is called the "crude difference", namely the simple difference (in absolute terms) between the projected and the observed value of the indicator under consideration. We do not refer to this as the absolute difference because this could easily be mistaken for the absolute value, i.e. disregarding the sign, of the difference. An additional indicator called the mean absolute percentage errors (MAPE) is used to summarize the extent of errors across the countries under consideration. This is calculated by averaging the absolute values of the percentage errors of different countries, i.e. not allowing an overestimation in one country to compensate for an underestimation in another country. Total errors are decomposed into base-line errors (difference between estimated and observed value for any indicator) and the change error (difference between projected and observed change over time). More details about the methodology for this can be found in Khan (2003).

3. Errors in the Early UN Population Projections

In the late 1950s, when UN experts, in collaboration with national and international demographers, wanted to produce population projections for individual countries in Southeast Asia, they had at their disposal an increasing empirical database derived from censuses, surveys and to some degree vital statistics.

At that time the data showed that mortality had started to decline in most of the countries in the region whilst birth rates remained unchanged at a very high level. As Figures 1-3 show, around 1955 the fertility transition had not yet started in Southeast Asia and the TFR was in the range of 5.5-7.5 for our selected countries. Even Singapore, soon to see a precipitous fertility decline, still had a TFR above 6.

The authors of the population projections published in 1958 and from which our data are derived did indeed speculate about the possibility of a fertility decline in the near future, but given the rather stable high fertility pattern in the whole region, they did not dare to make such an assumption for the main variant of their projections. They stuck with what they called "conservative assumptions" combining a continued decrease in mortality rate with essentially constant fertility rates until 1980, the time horizon of their projections. Although they affirmed their belief in the essential prediction of demographic transition theory, that a fertility decline would follow the mortality decline with some lag, they did not feel confident enough to assume that this would happen during their projection horizon. Nor did trends in other world regions seem to justify the assumption of declining fertility, as they state in the text: "There are, in fact, few areas in the world where significant decline from equally high birth rates has, so far, been observed" (UN 1958, p23).

They must, however, have felt a bit uneasy about disregarding the possibility of a fertility decline starting in the near future. This is why they added in a kind of appendix to the main chapter a section on "The highly speculative assumption of a fertility decline". They offer two alternative "highly speculative" fertility scenarios, one assuming that after 1960 (until then fertility was assumed to remain constant) the crude birth would decline by one percent per year and another one assuming a two percent decline – rates of decline found in those parts of the world that had already experienced *lasting* fertility declines. Their fertility assumptions were combined with the assumption of a continued moderate ("conservative") mortality decline. In the following analysis of projection errors we will (gracefully) disregard the two main projections that assume constant fertility and only study the two fertility decline scenarios.

Table 2 shows the results of the scenario assuming a one percent decline in the crude birth rate per year for three selected age groups (0-4, 35-39 and 70+) as well as the total population. Both sexes are combined since sex differentials are of less importance in this context. Since the two scenarios only differ in terms of the speed of the fertility decline after 1960 only the youngest age group is affected by the changing assumptions. The comparison shows that the fertility decline assumptions which were defined in an identical way for all six countries fitted the real country trends to greatly differing degrees. In Singapore fertility declined much more rapidly than even the two percent decline scenario assumed and the projections of the size of the youngest age group were off by 126 percent in case of the fast decline assumption and even 187 percent for the slow decline assumptions. In the slow decline scenario the number of children was also overestimated for Malaysia and the Philippines. It was underestimated, however, for Indonesia, Thailand and Vietnam. Viewed across all six countries the (population weighted) mean absolute percentage error (MAPE) is smaller (17.9 percent) for the slow decline scenario then for the fast decline scenario (33.3 percent). The errors for the size of the youngest age group are generally higher than those for the other age groups. For the total population as well as for the other age groups the mean absolute percentage errors were of the order of 13-16 percent. It can be seen from figures 3-4 that the projections are fairly accurate for the middle aged cohorts and that the errors are increased over the projection horizon. This confirms the findings of earlier studies.

These early UN projections clearly show how important it is for forecasters to undertake alternative projections based on what may appear at the time as unrealistic assumptions. They make a strong case for the explicit consideration of uncertainty in population forecasting.

4. Country-specific Patterns of Fertility Decline and the Sources of Error

The revisions of the 1975 and 1980 projections that were made in 1978 and 1982 show remarkable changes in estimates and assumptions for our selected countries when we consider that only 4 years separate them. Presumably this was due to new data becoming available that suggested significant revisions of earlier estimates and a greater differentiation in assumptions covering country-specific conditions.

Table 3 presents the crude and percentage errors of the 1975 projection (as revised in 1978) for three selected age groups and the total populations of the six countries. Projection errors were greatest for the youngest age group 0-4. Except for Malaysia and Singapore, the projected size of this age group was higher than the observed one in all countries. This can be mostly attributed to assuming too high fertility levels (Table 5). Only for Malaysia did the 1978 revision assume too low levels of future fertility (TFR = 4.26). As for the other four countries, for Singapore the assumed level of fertility was also too high but the number of children still turned out to be higher than projected because of higher immigration to Singapore than assumed. This same picture is also visible for the errors in total population size where the population of Singapore was greatly under-projected whereas that of Thailand was over-projected by almost a quarter. These are quite significant errors for only a 22 year time horizon. For the other countries the projection errors were less significant.

Projections for the 70+ population were too low by quite significant margins in all countries expect for the Philippines. This is mostly due to an under-estimate of future mortality declines. Life expectancy in 1995-2000 turned out to be several years higher than projected in 1978 for all countries except the Philippines (Table 7), where the pace of social and economic development was much slower than anticipated in the late seventies. The greatest underestimation of mortality improvement was for Vietnam, where life expectancy in 1995-2000 turned out to be 13 years higher than projected in 1978.

By 1982 the UN had significantly lowered their projections for all countries except Malaysia (Table 4). For the youngest age group, comparison with the observed data shows that for Thailand and Vietnam the downward adjustment of fertility assumptions was not sufficient whereas for the other countries they overdid the adjustment. For the age-group 35-39 the most significant error was for Singapore, this time because of a gross under-projection of immigration. The 1982 revised projections also underestimated the future increase in the numbers of elderly in four of the six countries. Only in Philippines did the number of elderly increase significantly slower than projected. Overall the mean absolute percentage errors (both weighted and unweighted) for the 1982 revision are quite a bit lower than those for the 1978 revision. As the more detailed error analysis below will show, this is not only due to the fact that the projection periods differ by four years but also due to significant adjustments made between the 1978 and 1982 revisions.

Much of the difference between the 1978 and 1982 revisions results from a change in fertility assumptions (Table 5), with respect to *both* the estimate of prevailing fertility conditions in 1975-1980 *and* the assumptions about future fertility decline. For all countries expect Malaysia the estimates of 1975-1980 fertility levels were significantly lower in the 1982 projections. Although we do not know the specific reasons for this major adjustment, we must assume that more up-to-date and accurate vital statistics had become available. Four of the six countries (all

except Singapore and Vietnam) participated in the World Fertility Survey (WFS) which for many developing countries gave the first reliable estimates of fertility levels. However, the surveys in these four countries had already been carried out in 1974-76 and only in the Philippines a bit later in 1978. Hence, it is not clear to what degree WFS and other surveys around that time (e.g. Knodel *et al.* 1987) played a role in these changes of estimates. The biggest downward adjustment in the TFR estimates were made for Thailand (from 5.53 to 4.27), for the Philippines (from 5.83 to 4.62) and Singapore (from 2.47 to 1.84). For Malaysia the estimate for 1975-80 was increased from 4.26 to 5.03. Comparing these adjustments of 1975-80 estimates to the observed data, it is interesting to note that for Thailand the adjustment was far too small (by almost two children per woman) whereas in the Philippines the adjustment had gone too far (by almost a child). For Malaysia the 1978 estimate turned out to be much closer to the observed value than the 1982 correction. In retrospect, when producing the 1982 revision the UN experts must have been realised that in 1978 they had failed to capture the ongoing fertility decline, and, in the course of adjusting for this, were overshooting with their subsequent adjustments. This is also reflected across all the countries in the fact that the mean absolute base line error in 1978 was only slightly worse than that in 1982.

There were also significant adjustments between 1978 and 1982 with respect to assumed future changes in fertility. For Indonesia, Malaysia and Vietnam the decline projected for the 20 year period 1975-80 to 1995-2000 was much greater (by almost one child) in 1982 than in 1978. For Thailand, the Philippines and Singapore the projected decline in 1982 was less than in 1978. For Singapore this is probably due to the fact that the estimated level was already below replacement and the UN has traditionally assumed that below replacement fertility is only temporary. The change error in the 1978 revision was largest in Vietnam (where fertility was assumed to decline by 1.45 children and actually declined by 3.39). In the 1982 revision this figure was much reduced, though for Malaysia a major error was made in the opposite direction (assuming a decline by 2.57 children when it turned out to be only 1.06). On average, the change error declined between 1978 and 1982 at a similar rate to the base line error.

Tables 6 and 7 show the errors made with estimates and projections for infant mortality and life expectancy. Here the pattern is a bit less complicated. In every country, except for the Philippines, infant mortality in 1995-2000 turned out to be lower than assumed in 1982. With respect to base and change errors the pattern is more difficult to interpret because of the above mentioned interaction. The Philippines again stands out as a country in which development and with it the decline in infant mortality came more slowly than had been expected. According to the recent UN statistics, life expectancy seemed to have increased quite dramatically in every country except Thailand compared to what the UN assumed in 1978 and 1982 projections. This however indicates the overall socio-economic development in the region for the last three-four decades. The underestimation of life expectancy has serious implications in understanding the ageing issues across these countries.

5. A Summary Assessment

Singapore stands out in our set of countries since it developed much more rapidly than had been anticipated. In this case, rapid social and economic development were associated with strong immigration flows, which caused the population to grow much more than expected. The Philippines are at the other end of the spectrum: here population size turned out to be higher than projected because of unexpectedly slow development, resulting in slower fertility decline and

slower mortality improvements. The greatest positive surprise, on the other hand, can be observed for Vietnam where conditions in the late 1970s actually turned out to be much better than assumed at the time. Infant mortality turned out to be much lower and life expectancy much higher than previously assumed by the UN, though not by the Vietnamese authorities who were very surprised at the continued use of such high mortality estimates for 1980 by the UN Population Division (Jones 1982).And on top of this base error, both mortality and fertility declined much more rapidly than assumed. Evidently the speed of recovery from the war and the subsequent development were beyond imagination. In Malaysia, finally it is interesting to note that fertility declined much more slowly than expected, presumably because of the pronatalist policies of the Malaysian government but also probably because of specific cultural and religious factors (Leete 1996). To be told that specific socio-economic development paths, culture and government policies matter greatly for demographic trends is hardly news. It is, however, interesting to see this reflected in the errors of population projections that had little choice but to assume rather similar trends across all countries.

Unlike the 1978 revision, the 1982 revision (base year of 1980) was quite accurate in many respects although it did not anticipate (1) the pro-growth policies of the Government of Malaysia adopted at about that time, (2) the continuing influence of the church and religion on the fertility level in the Philippines and (3) the volume of immigration to Singapore between 1980 and 2000. It also underestimated the speed of fertility decline in Thailand and Viet Nam and the levels of mortality during the Viet Nam war[1].

6. Conclusions and Lessons Learned

The analysis of the accuracy of past projections which at first glance may seem like a rather unimportant statistical exercise without much relevance for current practice turned out to become a fascinating story in terms of the intellectual history of thinking about population trends. The fact that the forecasters in the late 1950s were not daring to project in their main variants the great Asian fertility decline which now in retrospect seems so natural and self-evident is a great reason for humility about our capacity to anticipate major social changes.

The second lesson that we have learned from this analysis is that culture and politics matter a great deal for the specific paths of fertility and mortality. The understandably rather similar assumptions made by the UN for the six countries of the region turned out to be much too high for some countries and much too low for others. There is no easy solution to this problem in the absence of a good theory with predictive power telling us how specific cultural, social, economic and political conditions will affect fertility. The one thing that forecasting agencies can do is to try to learn quickly as time passes and more evidence becomes available and frequently update the population projections. Another thing that can be done is to have a more comprehensive approach to dealing with uncertainty in population projections and provide the user with uncertainty ranges that also cover trends which look less likely from today's perspective.

One thing we know for sure (almost) is that all projections being produced today will also have some errors. Actually the probability that the future population will turn out to be exactly as projected is close to zero. Population projection agencies such as national statistical offices or the UN Population Division have standardly accommodated uncertainty by producing more than one variant or scenario. These variants have been produced by assuming alternative fertility levels while applying the same mortality and migration assumptions. The UN still uses this approach,

which has the increasingly recognized disadvantage of neglecting the substantial uncertainties around future mortality and migration trends. This becomes particularly problematic as the emphasis of the analysis moves from population growth to population ageing. The future proportion of the population above e.g. age 70 or age 80 will be to a large extent determined by future trends in old age mortality, and the considerable uncertainties surrounding these developments need somehow to be incorporated in population projections. It is apparent also that whereas over-estimates of future fertility and mortality rates cancel out when it comes to total population size, they reinforce each other in projections of the speed and extent of population ageing. This is what happened with the UN projections not only in Southeast Asia but also in Europe and other regions (Keilman, 2001).

As a possible solution to this problem many statistical agencies, particularly in Europe, have moved to producing a larger number of scenarios based on alternative fertility, mortality and migration assumptions. While this is more reflective of the uncertainty in all three factors, it has the downside of being less 'user-friendly'. It does not tell the user which combinations of paths are more likely and how broad a range (in terms of likely outcomes) the scenarios cover, thus shifting to the user the burden of choosing among different assumptions. In this respect the UN approach of presenting the user with a "plausible range" between the high and low variants is more user-friendly, even we are not told exactly what "plausible" means in probabilistic terms. The only way for resolving both of these problems, i.e. covering uncertainty in fertility, mortality and migration trends and being explicit in terms of the uncertainty range covered, is to move to fully probabilistic projections. There has been a rapidly increasing literature on probabilistic population projections over the past years (Lutz and Scherbov, 1997; Lutz *et al*., 2000; Lutz and Goldstein, 2004) and different approaches seem to be showing some convergence. Yet a simple model that could be applied to every country in the world and at the same time satisfied large parts of the scientific community has still to emerge.

A final point demonstrated by the above analysis is the importance of correct information about the starting conditions in the jump-off year of any projection. The study shows clearly that in many cases the base line error was even more significant than the change error. While better demographic monitoring systems have clearly reduced the base line errors over past decades in some parts of the world, in other parts there is still quite some uncertainty about the exact levels of current fertility, mortality and even population size and age structure. Lutz *et al* (2007) have recently incorporated base line uncertainty into a probabilistic population projection model for China where there is considerable disagreement about the current level of fertility, and, as a consequence, about the number of children in the youngest age groups. While more can be done along this line for other countries in Asia and in Africa, it can only be the second best solution. The best solution is still to go out and collect better data.

Table 1. Analysis of the United Nations' population forecasts for six Southeast Asian countries.

Population	Reference	Source	Remarks
Base year 1950	UN (1958)	The population of South-East Asia (Including Ceylon and China: Taiwan) 1950-1980.	Total population and five-year age groups for the year 1980.
Base year 1960	UN (1966)	World Population Prospects as Assessed in 1963.	Population estimates, 1920-1960, and projections up to 1980, for countries in each region.
Base year 1975	UN (1980)	Selected Demographic Indicators by Country, 1950-2000: Demographic Estimates and Projections as Assessed in 1978.	Total population and five-year age groups for the year 2000.
Base year 1980	UN (1985)	World Population Prospects: Estimates and Projections as Assessed in 1982.	Total population and five-year age groups for the year 2000.
Observed 1980	UN (1994)	The Sex and Age Distribution of the World Populations: The 1994 Revisions.	Total population and five-year age groups for the year 1980. Testing accuracy in 1950 projection for population of 1980.
Observed 2000	UN (2007)	World Population Prospects: The 2006 Revision: Age and Sex.	Total population and five-year age groups for the year 2000. Testing accuracy in 1978 and 1982 projections for population of 2000.

Table 2. Crude and percentage errors in the 1950 projections: Scenario assuming 1 percent per year decline in Crude Birth Rates. (For the youngest cohort percentage error for the 2 percent decline scenario is given in parenthesis). Mean Absolute Percentage Errors (MAPE) are given in unweighted form as well as weighted by the sizes of the corresponding age groups of the populations.

Country	Forecasted in 1950 for 1980	Observed in 2006 for 1980	Actual error	Percentage error
Younger cohort: aged 0-4 years				
Indonesia	17934	22211	-4277	-19.3 (-37)
Malaysia	2300	1868	432	23.1 (-3)
Philippines	7960	7816	144	1.8 (-17)
Singapore	556	194	362	186.6 (126)
Thailand	6086	5903	183	3.1 (-24)
Viet Nam	5312	8175	-2863	-35.0 (-50)
		MAPE: unweighted= 44.8(43), weighted =17.9(33.3))		
Middle cohort: aged 35-39 years				
Indonesia	7176	8281	-1105	-13.3
Malaysia	613	700	-87	-12.4
Philippines	2441	2424	17	0.7
Singapore	119	136	-17	-12.5
Thailand	2060	2408	-348	-14.4
Viet Nam	2692	2126	566	26.6
			MAPE: unweighted = 13.3, weighted =13.3	
Older cohort: aged 70 years and above				
Indonesia	2882	2845	37	1.3
Malaysia	307	304	3	1.0
Philippines	736	857	-121	-14.1
Singapore	71	66	5	7.5
Thailand	642	1059	-417	-39.3
Viet Nam	1051	1547	-496	-32.1
			MAPE: unweighted = 15.9, weighted =16.2	
Total population				
Indonesia	130970	151108	-20138	-13.3
Malaysia	13078	13763	-685	-5.0
Philippines	47559	48088	-529	-1.1
Singapore	3074	2415	659	27.3
Thailand	39089	46809	-7720	-16.5
Viet Nam	42293	53005	-10712	-20.2
			MAPE: unweighted = 13.9, weighted = 12.8	

Table 3. Crude and percentage errors (in the 1975 projections as revised in 1978) for the year 2000, according to the UN medium variant. Mean Absolute Percentage Errors (MAPE) are given in unweighted form as well as weighted by the sizes of the corresponding age groups of the populations.

Country	Forecasted in 1975 for 2000	Observed in 2006 for 2000	Actual error	Percentage error
Younger cohort: aged 0-4 years				
Indonesia	23437	21366	2071	9.7
Malaysia	1972	2657	-685	-25.8
Philippines	9990	10101	-111	-1.1
Singapore	220	275	-55	-20.0
Thailand	8393	4684	3709	79.1
Viet Nam	9851	7890	1961	24.8
		MAPE: unweighted = 26.7, weighted =18.3		
Middle cohort: aged 35-39 years				
Indonesia	15955	14955	1000	6.7
Malaysia	1310	1708	-398	-23.3
Philippines	5216	4603	613	13.3
Singapore	273	406	-133	-32.7
Thailand	5012	4952	60	1.2
Viet Nam	4894	5545	-651	-11.7
		MAPE: unweighted = 14.8, weighted =9.0		
Older cohort: aged 70 years and above				
Indonesia	4923	5799	-876	-15.1
Malaysia	488	535	-47	-8.7
Philippines	1646	1528	118	7.7
Singapore	136	179	-43	-24.0
Thailand	1321	2464	-1143	-46.4
Viet Nam	1975	2694	-719	-26.7
		MAPE: unweighted = 21.4, weighted =22.3		
Total population				
Indonesia	221187	211693	9494	4.5
Malaysia	20165	23274	-3109	-13.3
Philippines	83930	76213	7717	10.1
Singapore	3095	4017	-922	-22.9
Thailand	76039	60666	15373	25.3
Viet Nam	79355	79094	261	0.3
		MAPE: unweighted = 12.7, weighted =8.1		

Table 4. Crude and percentage errors (in the 1980 projections as revised in 1982) for 2000 according to the UN medium variant. Mean Absolute Percentage Errors (MAPE) are given in unweighted form as well as weighted by the sizes of the corresponding age groups of the populations.

Country	Forecasted in 1980 for 2000	Observed in 2006 for 2000	Actual error	Percentage error
Younger cohort: aged 0-4 years				
Indonesia	20361	21366	-1005	-4.7
Malaysia	2016	2657	-641	-24.1
Philippines	8157	10101	-1944	-19.2
Singapore	194	275	-81	-29.4
Thailand	6834	4684	2150	45.9
Viet Nam	8827	7890	937	11.8
			MAPE: unweighted = 22.5, weighted = 14.4	
Middle cohort: aged 35-39 years				
Indonesia	14339	14955	-616	-4.1
Malaysia	1598	1708	-110	-6.4
Philippines	5290	4603	687	14.9
Singapore	284	406	-122	-30.0
Thailand	5060	4952	108	2.1
Viet Nam	5119	5545	-426	-7.6
			MAPE: unweighted = 10.8, weighted = 6.4	
Older cohort: aged 70 years and above				
Indonesia	5162	5799	-637	-10.9
Malaysia	561	535	26	4.8
Philippines	1750	1528	222	14.5
Singapore	125	179	-54	-30.1
Thailand	1715	2464	-749	-30.3
Viet Nam	2162	2694	-532	-19.7
			MAPE: unweighted = 18.3, weighted = 16.7	
Total population				
Indonesia	204486	211693	-7207	-3.4
Malaysia	20615	23274	-2659	-11.4
Philippines	74810	76213	-1403	-1.8
Singapore	2976	4017	-1041	-25.9
Thailand	66115	60666	5449	8.9
Viet Nam	78129	79094	-965	-1.2
			MAPE: unweighted = 8.7, weighted = 4.1	

Table 5. Total fertility rate (TFR).

Country	1978 revision			2006 assessment			Total error	Base error	Change error
	1975-1980	1995-2000	Projected TFR decline	1975-1980	1995-2000	Estimated TFR decline			
(1)	*(2)*	*(3)*	*(4) = (3)-(2)*	*(5)*	*(6)*	*(7) = (6)-(5)*	*(8)=(6)-(3)*	*(9)=(5)-(2)*	*(10)=(7)-(4)*
Indonesia	5.13	3.38	-1.75	4.73	2.55	-2.18	-0.83	-0.40	-0.43
Malaysia	4.26	2.7	-1.56	4.16	3.10	-1.06	0.40	-0.10	0.50
Philippines	5.83	3.75	-2.08	5.50	3.72	-1.78	-0.03	-0.33	0.30
Singapore	2.47	2.10	-0.37	1.87	1.57	-0.30	-0.53	-0.60	0.07
Thailand	5.53	3.28	-2.25	3.76	1.90	-1.86	-1.38	-1.77	0.39
Viet Nam	5.84	4.39	-1.45	5.89	2.50	-3.39	-1.89	0.05	-1.94

Country	1982 revision			2006 assessment			Total error	Base error	Change error
	1975-1980	1995-2000	Projected TFR decline	1975-1980	1995-2000	Estimated TFR decline			
Indonesia	4.81	2.46	-2.35	4.73	2.55	-2.18	0.09	-0.08	0.17
Malaysia	5.03	2.46	-2.57	4.16	3.10	-1.06	0.64	-0.87	1.51
Philippines	4.62	2.87	-1.75	5.50	3.77	-1.78	0.85	0.88	-0.03
Singapore	1.84	1.74	-0.10	1.87	1.57	-0.30	-0.17	0.03	-0.20
Thailand	4.27	2.51	-1.76	3.76	1.90	-1.86	-0.61	-0.51	-0.10
Viet Nam	5.48	2.87	-2.61	5.89	2.50	-3.39	-0.37	0.41	-0.78

Table 6. Infant mortality rate (IMR) for both sexes.

Country	1982 revision			2006 assessment			Total error	Base error	Change error
	1975-1980	1995-2000	Projected IMR decline	1975-1980	1995-2000	Estimated IMR decline			
(1)	*(2)*	*(3)*	*(4) = (3)-(2)*	*(5)*	*(6)*	*(7) = (6)-(5)*	*(8)=(6)-(3)*	*(9)=(5)-(2)*	*(10)=(7)-(4)*
Indonesia	99	57	-42	106.4	44.7	-61.7	-12.3	7.4	-19.7
Malaysia	33	20	-13	33.8	11.6	-22.2	-8.4	0.8	-9.2
Philippines	59	28	-31	70.3	34.4	-35.9	6.4	11.3	-4.9
Singapore	13	9	-4	12.5	3.5	-9.0	-5.5	-0.5	-5.0
Thailand	59	28	-31	44.3	15.7	-28.6	-12.3	-14.7	2.4
Viet Nam	106	58	-48	82.5	28.9	-53.6	-29.1	-23.5	-5.6

Table 7. Life expectancy (LE) birth for both sexes.

Country	1978 revision			2006 assessment			Total error	Base error	Change error
	1975-1980	1995-2000	Projected LE increase	1975-1980	1995-2000	Estimated LE increase			
(1)	*(2)*	*(3)*	*(4) = (3)-(2)*	*(5)*	*(6)*	*(7) = (6)-(5)*	*(8)=(6)-(3)*	*(9)=(2)-(5)*	*(10)=(7)-(4)*
Indonesia	50.7	60.9	10.2	52.7	66.0	13.3	5.1	2.0	3.1
Malaysia	65.3	69.5	4.2	65.3	71.9	6.6	2.4	0	2.4
Philippines	61.2	68.9	7.7	60.1	68.6	8.5	-0.3	-1.1	0.8
Singapore	69.7	73.1	3.4	70.8	77.2	6.4	4.1	1.1	3.0
Thailand	60.7	68.7	8.0	62.5	67.6	5.0	-1.2	2.4	-3.0
Viet Nam	48.1	59.6	11.5	55.8	70.7	14.9	11.1	7.7	3.4

Country	1982 revision			2006 assessment			Total error	Base error	Change error
	1975-1980	1995-2000	Projected LE increase	1975-1980	1995-2000	Estimated LE increase			
Indonesia	50.0	59.7	9.7	52.7	66.0	13.3	6.3	2.7	3.6
Malaysia	61.7	70.7	9.0	65.3	71.9	6.6	1.2	3.6	-2.4
Philippines	62.5	70.1	7.6	60.1	68.6	8.5	-1.5	-2.4	0.9
Singapore	70.8	74.4	3.6	70.8	77.2	6.4	2.8	0	2.8
Thailand	61.2	66.8	5.6	62.5	67.5	5.0	0.7	1.9	-0.6
Viet Nam	55.8	64.8	9.0	55.8	70.7	14.9	5.9	0	5.9

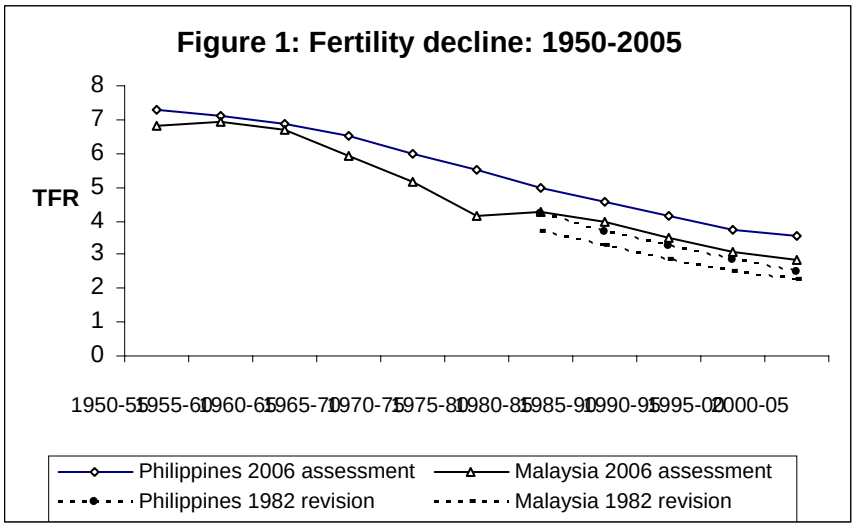
Figure 1: Fertility decline: 1950-2005
TFR
8
7
6
5
4
3
2
1
0
1950-55
1955-60
1960-65
1965-70
1970-75
1975-80
1980-85
1985-90
1990-95
1995-00
2000-05
Philippines 2006 assessment
Malaysia 2006 assessment
Philippines 1982 revision
Malaysia 1982 revision

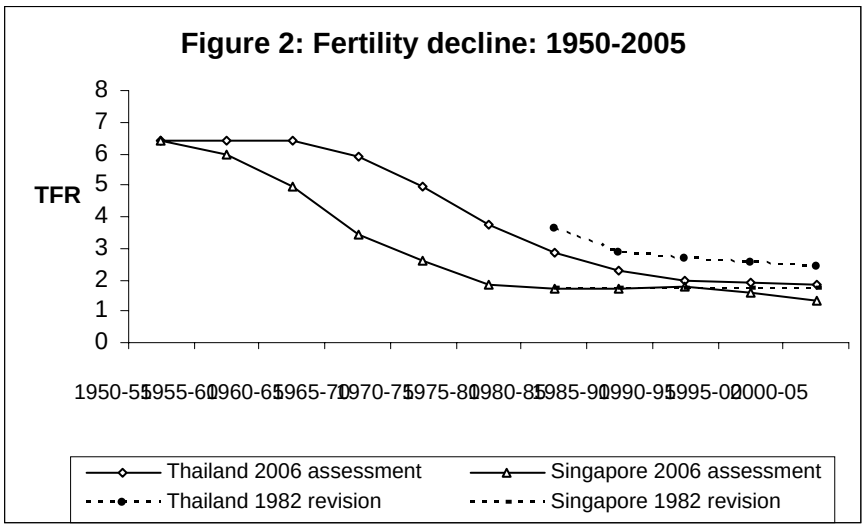
Figure 2: Fertility decline: 1950-2005
TFR
8
7
6
5
4
3
2
1
0
1950-55
1955-60
1960-65
1965-70
1970-75
1975-80
1980-85
1985-90
1990-95
1995-00
2000-05
Thailand 2006 assessment
Singapore 2006 assessment
Thailand 1982 revision
Singapore 1982 revision

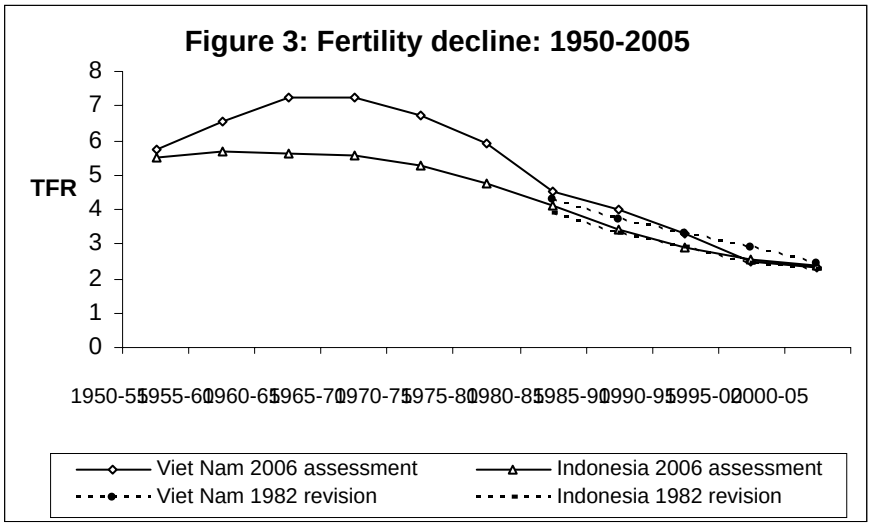
Figure 3: Fertility decline: 1950-2005
TFR
8
7
6
5
4
3
2
1
0
1950-55
1955-60
1960-65
1965-70
1970-75
1975-80
1980-85
1985-90
1990-95
1995-00
2000-05
Viet Nam 2006 assessment
Indonesia 2006 assessment
Viet Nam 1982 revision
Indonesia 1982 revision

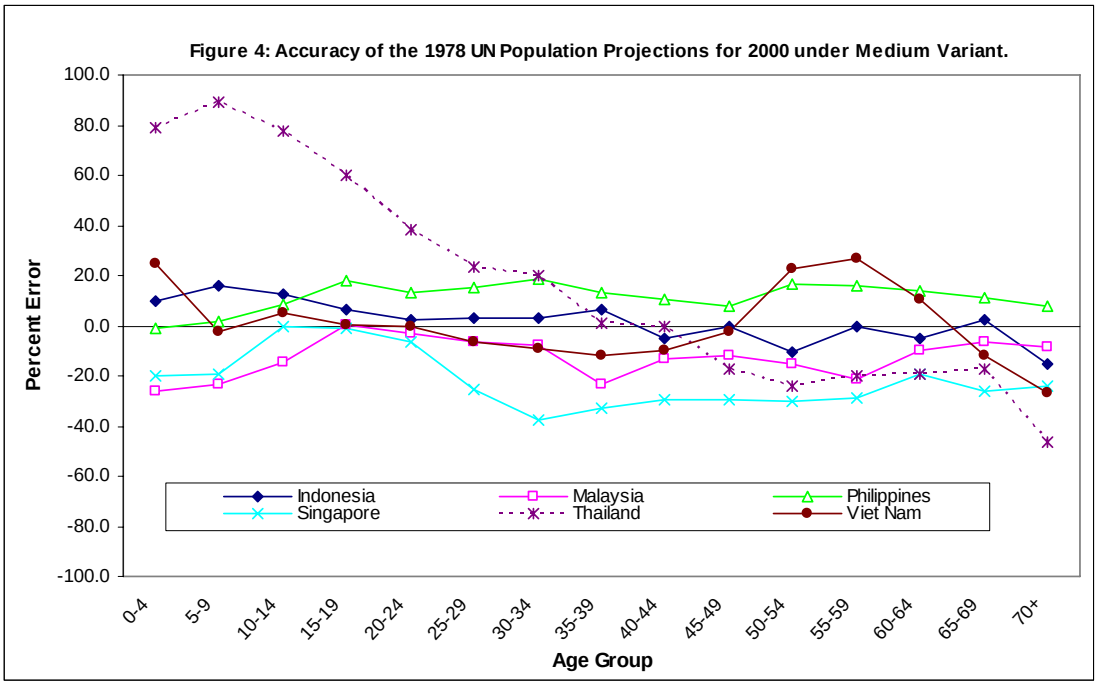
Figure 4: Accuracy of the 1978 UN Population Projections for 2000 under Medium Variant.
Percent Error
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70+
Age Group
Indonesia
Malaysia
Philippines
Singapore
Thailand
Viet Nam

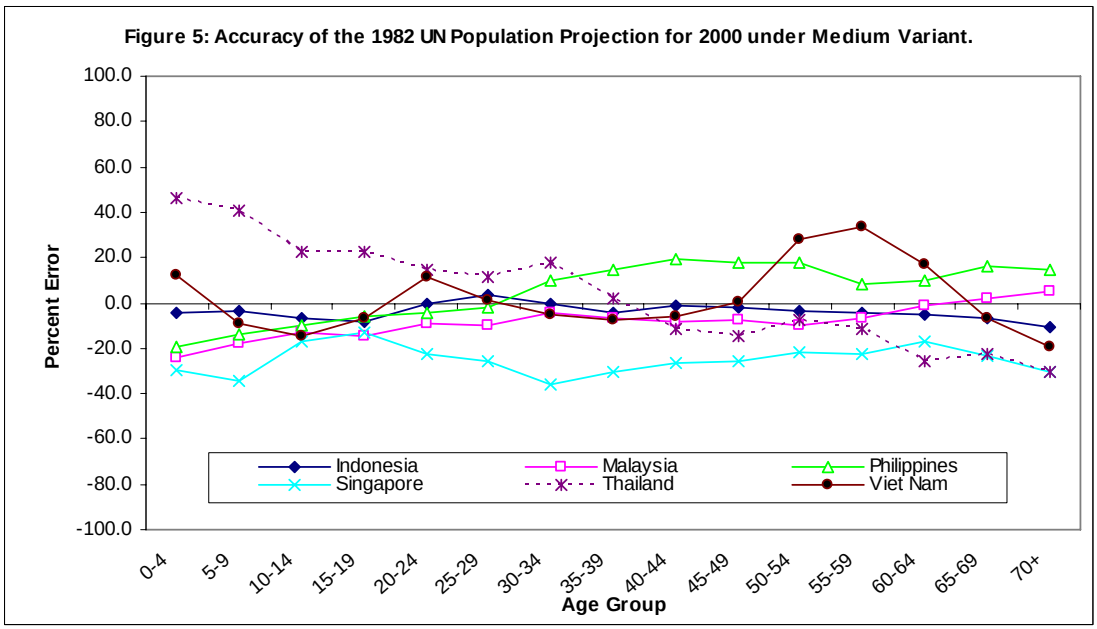
Figure 5: Accuracy of the 1982 UN Population Projection for 2000 under Medium Variant.
Percent Error
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
0-4
5-9
10-14
15-19
20-24
25-29
30-34
35-39
40-44
45-49
50-54
55-59
60-64
65-69
70+
Age Group
Indonesia
Malaysia
Philippines
Singapore
Thailand
Viet Nam

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