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IZA DP No. 2452

# The Babeldaob Road:
# The Impact of Road Construction on Rural
# Labor Force Outcomes in the Republic of Palau

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November 2006

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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# ABSTRACT

## The Babeldaob Road:
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This research examines the impact of road construction on rural labor force outcomes in a developing country. A new road built in the Republic of Palau links formerly inaccessible rural areas to more urban wage sector employment. We use two censuses conducted five years apart which perfectly bracket the road construction period. The data allow us to identify households that moved in the intervening five year period, thereby correcting any endogenous movement attributable to the road construction. Utilizing a difference-in-difference regression strategy and matched panel data, we find that households impacted by the new road construction tend to increase their wage sector employment, decrease their self-employment in agriculture, decrease the number of international migrants sent abroad and increase their ownership of automobiles. The findings also show that inequality decreases both within and between regions. The impact of road construction on average household wages and income is negligible.

JEL Classification: O18, R29, R40

Keywords: infrastructure, economic development, rural labor force

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## I. INTRODUCTION

Well designed, durable roads can greatly improve the conditions of rural populations. In developing countries, infrastructure represents, " … if not the engine, then the 'wheels' of economic activity." (World Bank Development Report, 1994, p.14) Decreased transportation costs increases the use of agricultural inputs and can increase rural household incomes from access to agricultural markets (Wanmuli 1991; Binswanger et al. 1993; Jacoby 2000; Jalan and Ravallion 2002; Van de Walle 2002; Gibson and Rozelle 2003; Edmonds 2004). Additionally, given the presence of agricultural productivity shocks, well-functioning roads reduce volatility in rural household consumption patterns where it is possible to send household members either to distant rural areas for marriage or to urban centers for wage employment (Rosenzweig and Stark 1989; Giles 2006).

In this research, we move away from looking at the impact of roads on agricultural outcomes and instead focus on changes in household participation in formal labor markets. Previous research emphasized the impact of roads on agricultural productivity, access to agricultural markets and on the ability to send domestic migrants. Here, we investigate rural household movement away from self-employment in agriculture and into wage sector employment once a new road is completed in a small developing country in the western Pacific Ocean. The economic changes are a precursor to social and customary changes as households move away from traditional and established economic activities to wage sector employment. We aim to document swift changes in economic activities due to the construction of a new road.

The Babeldaob road was constructed by the US Army Corps of Engineers in the Republic of Palau from 2001- 2004. The road connected rural households on the island of Babeldaob with the urban center, Koror. Access to the new road increased the wage sector employment opportunities for the rural households. We utilize two national censuses conducted in the Republic of Palau in 2000 and 2005, which conveniently bracket the entire road construction period. This unique set up allows us to answer the following question: How do household outcomes and labor force participation rates change for rural households when transportation costs to the urban wage center are reduced?

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To answer this question, we, first, pool the two censuses and employ a difference-in-difference procedure to assess the impact of the road on wage sector employment, self-employment, number of household international migrants and total wages. The censuses are particularly helpful as they contain information for previous residence (at the village level) at the time of the last census. This information on household movement between censuses allows us to correct for any endogenous household movement (both domestic and international) as a result of the new road construction.[1] We also link households between the two censuses, although imperfectly, to form a household panel.[2] Controlling for the unobserved heterogeneity of households by first-differencing the panel data, we find that the impact of the new road on household outcomes does not differ from that of the simple difference-in-difference results.

Our findings suggest that households respond quickly to the new employment opportunities once the new road is operational. For the households located in the new road region (the north island), we observe a marked increase in wage sector employment, a decrease in the self-employed in agriculture and a decrease in the number of international migrants from households relative to southern island households. Changes in average household wages, however, show no difference at all. One possible explanation for this result is that not all returns to road investment arrive at the same time. The time between completion of the road and the 2005 census was about six months, therefore, many of the new wage sector entrants may not have found the right job match yet. A subsequent look at these households after a year or more might reveal a completely different situation. Rural households may be quick in changing their sector of employment, but returns to these changes may not materialize immediately.

Section II provides an overview of the Republic of Palau, its history and details about the road construction and funding. Section III provides information about the two census data sets from 2000 and

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[1] It is impossible, however, to account for entire households that relocated abroad in this time period. Previous research indicates that migration abroad is seldom undertaken by entire households at once. Therefore, entire households that migrated abroad are probably a small fraction of this data. We can exclude new immigrant households to the Republic of Palau in this time period.

[2] No names or other explicitly unique identifiers exist in the census data we received. However, we are able to effectively match 76% of all Palauan households using birthdate, birthplace and sex characteristics of adult household members. The remaining mismatches are attributed to reporting error. See Section III for additional information on matching procedures.

2005 used in this research. The empirical strategy and results are presented in Section IV. A short discussion of the results is provided in Section V. Finally, Section VI concludes.

## II. PALAU INFORMATION AND ROAD CONSTRUCTION

The Republic of Palau is a small island nation located in the western Pacific Ocean near the Philippines. Figure 1 is a map of the Republic of Palau, the island of Babeldaob is the large landmass towards the top of the map (with an alternative spelling as Babulthuap). A former trust territory of the United States, the Republic of Palau became an independent nation in 1994. The 18,000 citizens of Palau reside on only nine of the 200 islands with the vast majority concentrated in the country capital of Koror. Gross Domestic Product in 2005 was estimated at $109 million dollars, which gives a per capita GDP of approximately $6,000. The economy of Palau consists of agricultural production, public administration and a highly developed tourism sector. The United States maintains close diplomatic ties with the Republic of Palau and provides financial support for some government operations and construction projects such as the Babeldaob road.

The northern island, Babeldaob, is comprised primarily of households engaged in self-employment in agriculture and fishing. The southern island, in contrast, contains households that are primarily employed in the wage sector with some mix of self-employment in agriculture. A new bridge linking the two islands, replacing an older, collapsed bridge, was completed in 2001. Therefore, the north can be thought of as the rural counterpart to the south's more urban environment. Wage employment in the south is concentrated in the highly developed international tourism market and public sector employment.

The Babeldaob road was constructed and financed by the US Army corps of engineers under an agreement with the Palau government. Figure 2 provides a detailed map of the Babeldaob road. The road is 54 miles long and encircles the entire northern island, which is the largest single land mass in the Republic of Palau. Previously, the lack of reliable roads on Babeldaob prevented a full integration of labor markets between the north and south regions of Palau.

**III. DATA DESCRIPTION**

This research uses two censuses conducted in the Republic of Palau in 2000 and 2005.[3] The two censuses are very similar in nature, which facilitates comparison between them. The censuses provide detailed information on the demographic composition of the household, assets of the household, extensive information on household emigrants as well as household location in the previous five years.

In 2000, there were 3359 households in Palau, the majority of which were concentrated in the southern part of Palau. Approximately 75% of the households resided in the urban center of Koror in the 2000 census. By 2005, total households (excluding new immigrant households) had increased to 4082 and the share residing in the south had decreased slightly to 72%.

An extremely important feature of the Palau censuses is that they provide information on the previous household location five years ago. This means that we can identify whether a household in 2005 has moved from one of the road states after the 2000 census. Armed with this valuable information, we can correct for endogenous movement of households in response to the road construction. Less than 8% of the Palauan population moved residences in this 5 year period.[4] However, we are concerned with household movements between the two regions and not necessarily within a region. Examining the data for the 2005 census, we find that approximately 6% of households report moving between regions during the past five years; the remaining two percent of movers stay within the same region (either the north island of Babeldaob or the southern region). The six percent of households that move between regions is essentially double that of the previous rate of movement as documented in the 2000 census; only 3% of households report living in a different region in 1995 than their current place of residence in the 2000 census. The data seem to indicate that there has not been a large amount of household movement in anticipation of the road construction (prior to the 2000 census).

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[3] Access to the data was provided by the International Programs Center at the US Census Bureau. The center also provided assistance and oversight with the administration of the Palau censuses.
[4] This amount does not include the influx of 2565 international immigrants (some return Palauan citizens and other not) from abroad in this period.

We created an indicator variable for the pooled census data to indicate whether a household is located in the road region or not. All households located on the island of Babeldaob are considered to be located in the road region. For the 2000 census, the coding was relatively simple – all households located on Babeldaob were coded one and the remaining households were coded with a zero. The coding of households for the 2005 census is slightly more complicated to correct for the households that had moved. For the year 2005, households that were currently located in the road region and had not moved in the previous five years were also coded one, all other households were coded with a zero. To correct for households that may have moved in response to the new road construction, which may confound the research results, we re-assigned households in 2005 to their previous village of residence using the information provided on location of previous residence 5 years ago from the 2005 census. Therefore, households residing in the road region in 2005 that were located in the non-road regions in 2000, were coded as zero for the road region variable in 2005; while households residing in the non-road regions of Palau in 2005 that were in the road region in the 2000 census were coded as one for the road variable. The correction here allows for an intention-to-treat estimation; the treatment of living in a road region is examined for all of the households, not just the ones that remained behind (the compliers). Only the households that moved(the non-compliers) within this time period had this correction. Additionally, new international migrant households that arrived after the 2000 census were removed from the analysis.

The censuses did not provide unique identifiers such as names or social security numbers. Therefore, it was not possible to perfectly identify either individuals or households between the two censuses. Birthdates, birthplaces and parent birthplaces are available in the data, however. Using this, we matched at least one individual from approximately 76% of the Palauan households in 2000. These households form the panel data set used in the first-differencing estimation to be described later.

Table 1 provides means for the variables used in this research. The four panels represent the mean values for the 2000 and 2005 censuses divided between households located in the road and non-road areas. Examining the differences over time between the road and non-road region, we see some interesting differences when looking only at these simple averages. Total household size decreases across

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both regions in this time period. There is a 16% percent decrease in household size for both regions. This is reflected in the relatively large increase in number of households over this five year period (net of international migration) which is 51% and 36% for the road and non-road regions respectively.

The number of household members employed in self-employment in agriculture decreases between 2000 and 2005. The decrease in self-employment in agriculture appears to have occurred equally between the two regions, which face a decrease of almost 50% of household members active in this labor force sector. Even more strikingly, the number of household members employed in the wage sector increases between the two censuses for rural households. We see a large, statistically significant increase for the road region households, while there is little change for the non-road households in wage sector employment.

In the road region, the number of international migrants per household decreases significantly between 2000 and 2005. There is a small increase in the number of international migrants per household for the non-road region, but this change is not statistically significant. Overall, the number of international migrants between the two regions, road and non-road, has converged to approximately 0.30 after the construction of the road. This is striking given that prior to the road construction there was a large difference in the number of international migrants by region; the road region had 0.43 migrants per household which is over 50% higher than the amount in the non-road region.

Average household wages increases between the two census years for both regions of Palau. Similarly, average total income also increases for three of the four measures provided in Table 1, although none of them are statistically significant. Wages and total income have been adjusted for inflation using price deflators from Hawaii as none were available for Palau.

Table 2 shows the change in household inequality by regions between the two censuses. The top panel of this table provides the change in the Gini coefficient for total household wages. The left half of the panel shows that there is higher inequality in the road region in 2000 relative to the non-road areas. By the 2005 census, however, there has been a reduction in inequality across and between regions; the difference between the two Gini coefficients is now only 3 percentage points apart, whereas it was 7

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percentage points previously.  The right panel removes recent immigrants to Palau (arriving after the 2000 census) and the results are very similar to the previous panel.  In both cases, the road region experiences the biggest reduction in inequality between 2000 and 2005; however, the road region has higher levels of inequality initially.  This provides some evidence for convergence across the two regions, which is what we would expect given that the new road provides for a lower cost flow of goods and labor between the two areas.

The lower half of table 2 examines the Gini coefficient using total household income.  This measure includes household wages, transfer payments and other types of non-labor income; self-employment earnings for agriculture are not reported and are not included in this measure.  The results closely match those presented above.  Once again it is evident that the road region suffered from higher levels of overall inequality in 2000 and experienced a substantial decrease in inequality by the year 2005.  Inequality appears to have stabilized between the two regions in a Gini coefficient range of 0.48-0.44.

The results of these simple differences in means and inequality measures illustrate our over all research results quite nicely.  After road construction, the road region households are less engaged in self-employment in agriculture, more likely to be employed in wage sector employment and have decreased the number of international migrants relative the non-road region.  The increase in wages and income across census years will be shown to be statistically insignificant once we control for other variables; the effect of the new Babeldaob road has no discernible impact on average household wages or income.  Inequality appears to have decreased in absolute terms and between regions in this time period.

**IV.  ESTIMATION STRATEGY AND RESULTS**

In order to identify the causal effect of road construction on labor market outcomes, we employ two different methods: a difference-in-difference procedure and first-differencing procedure.  The censuses conducted in Palau in 2000 and 2005 are first pooled and a difference-in-difference procedure estimates the impact of road construction on household labor market choices.  The second procedure requires linking households across the two censuses using time-invariant characteristics present in the

data.  The panel data allows us to effectively remove any unobserved heterogeneity present in households that may be correlated with household location or employment sector choices.

## A. POOLED CENSUS DATA AND DIFFERENCE IN DIFFERENCE ESTIMATION

Simply pooling the census data and conducting a difference-in-difference procedure would not yield entirely accurate results.  As mentioned earlier, individuals and households may have moved during the five year time period between the censuses; these individuals could potentially confound our results.  The moves may be endogenously related to the newly constructed road.  If all high ability households move from the rural countryside to the urban sector and we observe that the remaining households have lower incomes after the road is built we may erroneously conclude that road construction tends to lower household incomes.  We care explicitly about the impact that the road had on households residing in and outside of the road construction areas.  Therefore, we must account for the households that move within this five year time period.

Since it is possible to identify all of the movers in this five year period, we re-assign the movers to their region of origin.  We can also omit new immigrant households to Palau that arrived after the 2000 census given the information on previous household location in the previous 5 years.  The newly arrived households are endogenously moving to the various states in Palau and they, too, would tend to confound any impact of road construction.  Immigrants comprise a large part of population growth in Palau and, therefore, the impact of new households on outcomes may not be trivial.   After correcting for the domestic movers and omitting the new immigrant households, the standard difference-in-difference methods are carried out on the pooled data set.

In this research, treatment consists of living in a state where the new road was constructed between the 2000 and 2005 censuses.  The control areas are the remaining states in the Republic of Palau. The empirical specification is given below.

(1)  $Y_{it} = \alpha_{0it} + X_{it}'\alpha_1 + \alpha_2 * Road_i + \alpha_3 * Year_t + \alpha_4 * Road_i * Year_t + \varepsilon_{it}$

In this equation, Y represents the outcome of interest for household i at time t. The vector X represents a set of household head and household characteristics: education, age, annual work hours, average household income levels, and household size. The dummy variable Road identifies whether a household is located in 2000 or 2005 in one of the states where the new road was built. In the estimation results to follow both the raw data and the corrected data (for household movement) are presented. The Year dummy variable identifies whether the observation is drawn from the first census in 2000 (code = 0) or the second census in 2005 (code = 1). The coefficient of interest is $\alpha_4$ which provides the effect of road construction on household outcome variables and $\varepsilon$ represents the idiosyncratic error for each observation.

B. PANEL DATA AND FIRST DIFFERENCING ESTIMATION

While the pooling of the two censuses allows us to conduct a difference-in-difference estimation procedure, there may be some concern that there are systematic differences in unobserved heterogeneity between the road and non-road region households. If households endogenously located in either the road or non-road regions prior to the 2000 census, then the distribution of their unobserved characteristics will not be equal and may confound any effect of road construction on labor force outcomes. Therefore, first differencing this unobserved time invariant heterogeneity will eliminate the concerns about households that endogenously moved in anticipation of road construction.

The first difference regression equation is given below.

(2) $\Delta Y_{it} = \Delta \alpha_{0it} + \Delta X_{it}' \alpha_1 + \alpha_2 * \Delta Road_i + \Delta \varepsilon_{it}$

In this equation, the coefficient of interest is $\alpha_2$ which is consistently estimated if the unobserved heterogeneity truly is time invariant. The vector X represents the same control variables used in the pooled difference in difference estimation described above.

C. ESTIMATION RESULTS

Table 3 provides the estimation results from the intention-to-treat corrected difference-in-difference regressions. We first examine the number of cars owned by households in Palau. Cars, quite obviously, have a high utility value when new roads are constructed. The first column in Table 3 uses the

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entire data set, prior to any correction for endogenously moving domestic households and new international immigrant households. The second column corrects for these endogenous movers and omits the international immigrant households that arrived after the 2000 census. The coefficient of interest is the interaction term, which is statistically significant at the 1% significance level for the two different data sets. The positive coefficient indicates that households located in the road areas are more likely to have increased their car ownership relative to households located in the non-road areas. This result indicates a profound change in consumption patterns. Better roads increase the ownership of vehicles even when other things are held constant such as household income, household size and sector of employment. The final column provides the results from the first-differencing estimation results which uses the panel data. The results are closely in line with that of the pooled cross-section data estimates. Given that the mean number of cars owned in the road region prior to the road construction was 0.96 per household, the estimated coefficient on road construction indicates that ownership of cars by rural households increased by about 16% relative to the non-road areas.

The next table indicates that households located in the road region increased their wage sector employment and decreased their self-employment in agriculture relative to the households in non-road regions over the 2000-2005 time period. The first section of Table 4 shows the impact of road construction on the number of household members employed in the wage sector holding other things constant. In column two, we see that the impact of road construction increases the number of household members in the wage sector in a positive and statistically significant way. The coefficient gets larger and remains statistically significant when new international immigrant households and domestic movers are accounted for in the data. The final column, once again, reflects the fixed effects estimation and the coefficient estimates indicate that households from the road region increase their wage sector employment.

The next section in Table 4 shows the change in the number of household members that are self-employed in agriculture. The first two columns indicate that the new road decreases self-employment in agriculture by 0.147 household members; given that the mean level of self-employment in the road region

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in 2000 of 0.38, the treatment of the new road construction reduces self-employment by 38% within a household. The point estimates are the same whether or not we correct for the endogenously moving households and new immigrant households. The point estimate does change, however, when we use the panel data. The impact of the new road on self-employment in agriculture diminishes by more than a half, but remains statistically significant.

Table 5 looks at the number of immigrants each household sends abroad. Given the close relationship between Palau and the United States, Palauan citizens are allowed free entry into the United States. Therefore, there are relatively minor obstacles to migrating to the United States (primarily to Guam and Hawaii) other than the direct cost aspect. Hawaii and Guam may be regarded as merely as more distant urban centers given the relative ease of migration. The first two columns of numbers show that the rural households impacted by new road construction tend to decrease the number of international migrants sent abroad. Given that the point estimate is 0.093 and a typical household has 0.42 immigrants abroad, then road construction reduces the amount of international migrants by about 20%.

The results of Tables 3, 4 and 5 indicate the quick and dramatic changes that may occur with road development. Households quickly change their employment decisions shifting from self-employment to wage sector employment once it becomes easier to travel to the wage sector region. Households alter their assets to make best use of the new road – they increase their ownership of cars. Households also react to changes in road quality by reducing the number of members they send abroad. Once new employment opportunities are possible domestically some household members that otherwise would have left for employment abroad remain in the home country. For a small, developing country the construction of a new road has immediate and dramatic impact.

In contrast, table 6 provides an analysis of the impact of road construction on average household income. It appears that the road does not improve conditions for household incomes in the affected region and there is slight evidence that average wages may decrease. The first four numerical columns take average household wages as the dependent variable. The first two columns use total household adults and total household member total as the divisor in the dependent variable. The first column

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therefore represents the impact of road construction on average wages of adult household members, while the second numerical column is average wages for the entire household. In both cases, the point estimate is negative, but not statistically significant at conventional levels. The next two columns use the panel data and show that the point estimate for the estimated coefficient on the road variable is negative and statistically significant at the 10% level for the dependent variable that uses the number of household adults as the divisor. The fourth column shows that the wages are not impacted by road construction.

The next set of columns uses total household income divided by the number of household adults or total household members as the dependent variable. In all four columns, we see that the estimated coefficient on the road variable is negative, but not statistically significant at conventional levels. The results suggest that the overall standing of the household in financial terms has not changed dramatically given the presence of the new road.

## V. DISCUSSION

The impact of a new road on household outcomes occurred relatively quickly with respect to employment choices and asset accumulation, but was almost non-existent in terms of wages and total incomes. The lack of discernible impact on wages or income may be due to the short time frame this research covers. The 2005 census was conducted just six months after the completion of the road construction in 2004. While large sections of the Babeldaob road had been completed earlier, the full use of the road was not possible until a short time before the census was enumerated. Therefore, it is possible that, at the time of the census enumeration, the rural households had not made a full transition into the wage sector employment in the south. We have already documented the increase in wage sector employment by rural households, it may be the case that these new wage sector entrants have not settled on their optimal job matches at the time of the 2005 census.

Related to the timing of the road completion and census enumeration, there may not have been enough time for sufficient investment in local businesses on Babeldaob island by the time of the 2005 census. Currently rural households employed in the wage sector travel to the south islands for employment; in the future, there may be substantial wage sector employment opportunities in the north.

Babeldaob is the largest single land mass in Palau; completion of the new road makes new housing, business and government investment much more possible. It is possible that in the future there will be expanded wage sector employment and business ownership on Babeldaob island which will increase household incomes.

While we see no real change in incomes or wages in this short time period, households are quick to respond in changing their employment decisions. Optimizing households re-directs members from self-employment in agriculture to the wage sector. Households also reduce the amount of international migrants sent abroad. The revealed preference story is that the rural households have a strong desire for wage sector employment relative to self-employment in agriculture.

To some extent, wage sector employment in the urbanized south is a substitute for working abroad. As mentioned earlier, citizens of the Republic of Palau may freely enter the United States to live or work with little real obstacles. This research suggests that rural households on the northern island of Babeldaob were sending international migrants because prior to the road construction there were few wage sector employment opportunities (due to the high transportation costs) for the rural households. Other work conducted in the Federated States of Micronesia (Akee 2006) indicates that immigrants from that developing country are positively selected with regard to abilities and education. Therefore, the new road may be seen as an important long-term development strategy that increases the retention of human capital.

## VI. CONCLUSION

The research conducted here provides a unique look at the impact of development activities on rural communities. In many cases, the impact of infrastructure development may be obscured by other programs or confounding effects. In other cases, the scale of infrastructure development may be dwarfed by the size of existing communities so that the resulting effects are miniscule. The Babeldaob road in Palau is a case study which does not suffer from either of these problems; there was little other development programs occurring on this scale or at this time in Palau.

The data shows conclusively that the households residing in the road regions are more likely to increase their wage sector employment and to decrease their self-employment in agriculture. The dramatic change shows how development and infrastructure investment can quickly transform rural communities. These same households increased their ownership of cars as well. The households in the road regions also decreased the amount of international migrants from their households. The reduction in international migrants from these households accords with predictions that the road would increase wage sector opportunities as the costs of transportation decreased dramatically between the two regions in Palau.

Understanding the speed at which infrastructure development spurs demographic and economic changes in formerly rural communities is helpful in predicting the success of similar development elsewhere. In this research, the road impacted not only the economic activities of the rural households but also the societal norms by reducing household size. Indeed, the shift from self-employment in agriculture to wage sector employment is also a change to societal norms. In the not too distant past, the Republic of Palau was comprised of mostly self-employed farmers and fishermen. Centuries of customs, culture and norms have been built up around agriculture and are now quickly being replaced by the introduction of roads and wage sector employment.

It remains to be seen how the passage of time and increased investment further impact household consumption and employment choices. The next Palau census will be conducted in 2010 which should be sufficient for further investment to occur on Babeldaob. In the five year period, there might also be large population movements as more housing, hotel and resort development occurs on the northern island. It is likely that the exit from self-employment will be even more pronounced in the 2005-2010 time period for Palau.

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Table 1. Means of Variables by Year and Region in Palau

| | 2000 | | | 2005 | | |
|---|---|---|---|---|---|---|
| Road Region | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. |
| Household Head Age | 826 | 52.79 | 16.05 | 1253 | 50.83 | 15.49 |
| Household Head Education | 826 | 10.57 | 4.87 | 1253 | 11.45 | 4.53 |
| Household Total Income | 826 | 15922.76 | 43537.13 | 1253 | 13876.80 | 15587.92 |
| Number in Household | 826 | 4.78 | 2.96 | 1253 | 3.99 | 2.40 |
| Household Members Self-Employed | 826 | 0.37 | 0.66 | 1253 | 0.19 | 0.54 |
| Household Members in Wage Employment | 826 | 1.36 | 1.31 | 1253 | 1.58 | 1.19 |
| Number of Migrants in Household | 826 | 0.42 | 1.04 | 1253 | 0.29 | 0.86 |
| Number of Automobiles | 826 | 0.96 | 0.92 | 1253 | 1.11 | 0.87 |
| Average Total Hours in Wage Employment | 632 | 1959.99 | 696.23 | 1067 | 1910.87 | 728.14 |
| Average Wages Per Total Household Members | 826 | 2792.70 | 5504.34 | 1253 | 3474.81 | 3655.34 |
| Average Wages Per Household Adult | 826 | 3905.33 | 6491.01 | 1253 | 4581.69 | 4441.91 |
| Average Total Income Per Total Household Members | 826 | 3811.93 | 8673.57 | 1253 | 3998.53 | 5837.31 |
| Average Total Income Per Household Adult | 826 | 5308.23 | 12462.91 | 1253 | 5263.63 | 6719.64 |

| | 2000 | | | 2005 | | |
|---|---|---|---|---|---|---|
| Non-Road Region | Obs | Mean | Std. Dev. | Obs | Mean | Std. Dev. |
| Household Head Age | 2533 | 49.33 | 14.68 | 3454 | 47.72 | 14.46 |
| Household Head Education | 2533 | 12.17 | 4.52 | 3454 | 12.40 | 3.92 |
| Household Total Income | 2533 | 21276.15 | 31856.27 | 3454 | 20201.12 | 24694.39 |
| Number in Household | 2533 | 4.99 | 3.11 | 3454 | 4.21 | 2.74 |
| Household Members Self-Employed | 2533 | 0.06 | 0.26 | 3454 | 0.03 | 0.18 |
| Household Members in Wage Employment | 2533 | 1.91 | 1.73 | 3454 | 1.86 | 1.41 |
| Number of Migrants in Household | 2533 | 0.28 | 0.83 | 3454 | 0.26 | 0.82 |
| Number of Automobiles | 2533 | 1.30 | 1.04 | 3454 | 1.20 | 1.01 |
| Average Total Hours in Wage Employment | 2214 | 1994.22 | 691.55 | 3124 | 2012.05 | 675.31 |
| Average Wages Per Total Household Members | 2533 | 4313.36 | 6999.09 | 3454 | 5163.27 | 5275.25 |
| Average Wages Per Household Adult | 2532 | 5772.64 | 8346.85 | 3454 | 6681.20 | 6239.61 |
| Average Total Income Per Total Household Members | 2533 | 5169.26 | 9017.83 | 3454 | 5424.84 | 8238.37 |
| Average Total Income Per Household Adult | 2532 | 6820.19 | 9960.30 | 3454 | 7009.11 | 9303.69 |

**Table 2.  Measures of Household Inequality by Region and Year in Palau**

Gini Coefficient for Total Household Wages

| All Households | | | | Recent Immigrant Households (in 2005) Removed | | |
|---|---|---|---|---|---|---|

| | Road Area | Non-Road Area | | | Road Area | Non-Road Area |
|---|---|---|---|---|---|---|
| 2000 | 0.58 | 0.51 | | 2000 | 0.58 | 0.51 |
| 2005 | 0.48 | 0.45 | | 2005 | 0.47 | 0.43 |

| Change in Inequality 2000-2005 | | | | Change in Inequality 2000-2005 | | |
|---|---|---|---|---|---|---|
| | -0.17 | -0.12 | | | -0.19 | -0.16 |

Gini Coefficient for Total Household Income

| All Households | | | | Recent Immigrant Households (in 2005) Removed | | |
|---|---|---|---|---|---|---|

| | Road Area | Non-Road Area | | | Road Area | Non-Road Area |
|---|---|---|---|---|---|---|
| 2000 | 0.55 | 0.5 | | 2000 | 0.55 | 0.5 |
| 2005 | 0.48 | 0.46 | | 2005 | 0.46 | 0.44 |

| Change in Inequality 2000-2005 | | | | Change in Inequality 2000-2005 | | |
|---|---|---|---|---|---|---|
| | -0.13 | -0.08 | | | -0.16 | -0.12 |

**Table 3.  Impact of Road Construction on Automobile Ownership in Palau**

|  | Number of Cars | | Number of Cars |
| --- | --- | --- | --- |
|  | Total Census Data | Intention-to-Treat | Total Census Data |
| Interaction Term | **0.210***** | **0.156***** | **0.166***** |
|  | **[0.045]** | **[0.047]** | **[0.050]** |
| Road Region | -0.182*** | -0.181*** |  |
|  | [0.035] | [0.036] |  |
| Year 2005 | -0.03 | 0.013 |  |
|  | [0.023] | [0.023] |  |
| Household Head Age | 0.009*** | 0.008*** | -0.001 |
|  | [0.001] | [0.001] | [0.001] |
| Household Head Education | 0.045*** | 0.044*** | 0.001 |
|  | [0.003] | [0.003] | [0.004] |
| Total Household Income | 0.000*** | 0.000*** | 0.088*** |
|  | [0.000] | [0.000] | [0.008] |
| Number in Household | 0.091*** | 0.082*** | 0.000*** |
|  | [0.004] | [0.005] | [0.000] |
| Household Members Self-Employed | -0.058** | -0.045 | -0.025 |
|  | [0.028] | [0.028] | [0.042] |
| Household Members in Wage Employment | 0.083*** | 0.108*** | 0.077*** |
|  | [0.008] | [0.009] | [0.015] |
| Constant | -0.430*** | -0.380*** | 0.076*** |
|  | [0.062] | [0.066] | [0.026] |
| Observations | 8066 | 7435 | 2575 |
| R-squared | 0.26 | 0.25 | 0.15 |

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

**Table 4.  Impact of Road Construction on Sector of Employment for Households in Palau**

| | Number of Household in Wage Sector | | Number of Household in Wage Sector | | Number of Household Self-Employed in Agriculture | | Number of Household Self-Employed in Agriculture |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | Total Census Data | Intention-to-Treat | Total Census Data | | Total Census Data | Intention-to-Treat | Total Census Data |
| Interaction Term | 0.277*** | 0.304*** | 0.278*** | | -0.147*** | -0.141*** | -0.064*** |
| | [0.061] | [0.062] | [0.069] | | [0.018] | [0.019] | [0.024] |
| Road Region | -0.370*** | -0.380*** | | | 0.299*** | 0.299*** | |
| | [0.047] | [0.046] | | | [0.014] | [0.015] | |
| Year(2005) Dummy | 0.130*** | 0.055* | | | -0.014 | -0.011 | |
| | [0.031] | [0.031] | | | [0.009] | [0.010] | |
| Household Head Age | -0.019*** | -0.016*** | -0.005*** | | 0.002*** | 0.002*** | 0 |
| | [0.001] | [0.001] | [0.001] | | [0.000] | [0.000] | [0.000] |
| Household Head Education | 0.011*** | 0.014*** | 0.017*** | | -0.003*** | -0.004*** | 0 |
| | [0.004] | [0.004] | [0.005] | | [0.001] | [0.001] | [0.002] |
| Total Household Income | 0.000*** | 0.000*** | 0.000*** | | -0.000*** | -0.000*** | 0 |
| | [0.000] | [0.000] | [0.000] | | [0.000] | [0.000] | [0.000] |
| Number in Household | 0.287*** | 0.275*** | 0.298*** | | 0.013*** | 0.014*** | 0.020*** |
| | [0.005] | [0.005] | [0.009] | | [0.001] | [0.002] | [0.003] |
| Constant | 1.109*** | 1.003*** | -0.007 | | -0.056** | -0.048* | -0.022* |
| | [0.085] | [0.086] | [0.035] | | [0.025] | [0.027] | [0.012] |
| Observations | 8066 | 7435 | 2575 | | 8066 | 7435 | 2575 |
| R-squared | 0.37 | 0.38 | 0.33 | | 0.11 | 0.11 | 0.02 |

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

**Table 5. Impact of Road Construction on the Number of International Migrants from Palau Households**

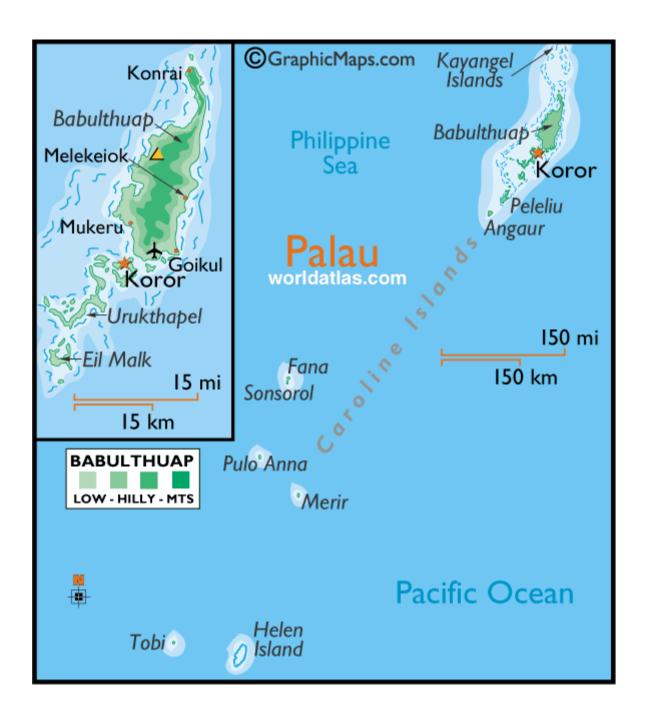| | Number of International Migrants Per Household | | Number of International Migrants Per Household |
|---|---|---|---|
| | Total Census Data | Intention-to-Treat | Total Census Data |
| Interaction Term | **-0.080**** | **-0.093**** | **-0.099*** |
| | **[0.039]** | **[0.042]** | **[0.051]** |
| Road Region | 0.097*** | 0.109*** | |
| | [0.031] | [0.032] | |
| Year(2005) Dummy | 0.111*** | 0.101*** | |
| | [0.020] | [0.021] | |
| Household Head Age | 0.006*** | 0.006*** | -0.001 |
| | [0.001] | [0.001] | [0.001] |
| Household Head Education | 0.011*** | 0.013*** | 0.001 |
| | [0.002] | [0.002] | [0.004] |
| Total Household Income | 0.000* | 0.000** | 0.000** |
| | [0.000] | [0.000] | [0.000] |
| Number in Household | 0.162*** | 0.170*** | 0.219*** |
| | [0.004] | [0.004] | [0.008] |
| Household Members Self-Employed | -0.016 | -0.025 | -0.138*** |
| | [0.024] | [0.025] | [0.042] |
| Household Members in Wage Employment | -0.163*** | -0.174*** | -0.207*** |
| | [0.007] | [0.008] | [0.015] |
| Constant | -0.651*** | -0.713*** | 0.084*** |
| | [0.054] | [0.059] | [0.026] |
| Observations | 8066 | 7435 | 2575 |
| R-squared | 0.23 | 0.24 | 0.23 |

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

**Table 6. Impact of Road Construction on Average Wage Income and Average Total Income in Palau Households**

| | Average Wages Per Household Adult | Average Wages Per Total Household Members | Average Wages Per Household Adult | Average Wages Per Total Household Members | Average Total Income Per Household Adult | Average Total Income Per Total Household Members | Average Total Income Per Household Adult | Average Total Income Per Total Household Members |
|---|---|---|---|---|---|---|---|---|
| Interaction Term | **-462.708** | **-297.593** | **-887.231*** | **-327.812** | **-430.166** | **-71.373** | **-691.723** | **-5.262** |
| | **[376.456]** | **[319.898]** | **[491.119]** | **[353.485]** | **[501.035]** | **[418.115]** | **[734.485]** | **[562.304]** |
| Road Region | -876.001*** | -832.620*** | | | -521.599 | -740.031** | | |
| | [296.794] | [252.205] | | | [395.011] | [329.638] | | |
| Year(2005) Dummy | 238.219 | 324.609** | | | -404.070* | -226.954 | | |
| | [182.398] | [154.995] | | | [242.759] | [202.583] | | |
| HH Age | 28.148*** | 33.263*** | -42.809*** | -14.838** | 67.934*** | 66.547*** | -42.532*** | -8.454 |
| | [6.179] | [5.251] | [9.533] | [6.857] | [8.224] | [6.863] | [14.257] | [10.907] |
| HH Education | 528.935*** | 411.065*** | 191.227*** | 69.594*** | 649.009*** | 503.410*** | 234.193*** | 88.900** |
| | [21.272] | [18.076] | [36.451] | [26.172] | [28.311] | [23.625] | [54.514] | [41.633] |
| Avg Hours/Per Worker | 1.114*** | 0.847*** | 0.171 | 0.687*** | 1.303*** | 0.996*** | 0.556* | 0.632*** |
| | [0.113] | [0.096] | [0.218] | [0.154] | [0.151] | [0.126] | [0.325] | [0.245] |
| Constant | -3,697.883*** | -3,578.151*** | 2,239.613*** | 970.970*** | -6,534.102*** | -5,848.975*** | 1,738.463*** | 425.383 |
| | [542.866] | [461.308] | [227.630] | [163.626] | [722.515] | [602.941] | [340.429] | [260.287] |
| Observations | 7037 | 7037 | 2105 | 2098 | 7037 | 7037 | 2105 | 2098 |
| R-squared | 0.11 | 0.09 | 0.01 | 0.01 | 0.09 | 0.07 | 0.01 | 0.01 |

Standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

**Figure 1.  Map of the Republic of Palau**



**Source: http://worldatlas.com/webimage/countrys/oceania/pw.htm**

**Figure 2. Map of the Babeldaob Road**



Source: US Army Corps of Engineer