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# Oil, Labor Markets, and Economic Diversification in the GCC: An Empirical Assessment

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**Abstract**: In a bid to reduce their dependency on oil and natural gas revenues, GCC governments have recently invested considerable resources to diversify their economies. This paper provides an empirical assessment of economic diversification in the GCC for the period 1980–2005. In particular we assess whether oil and natural gas revenues, government policies and foreign flows of labor have contributed to greater economic diversification, proxied by real growth in non-hydrocarbon GDP per worker. To our knowledge, this is the first paper that analyzes economic diversification in the Gulf using panel data techniques that explicitly treat the GCC as an economic block.

We find that lagged hydrocarbon revenue is the only variable consistently associated with subsequent economic diversification; this is in contrast to government expenditures whose impact on diversification is negative, large, and significant. We also find that population growth has little impact on either growth of overall GDP per worker or non-hydrocarbon GDP per worker; we present an economic growth model that takes into account features of the labor market structure in the Gulf to explain this finding. Finally, we present some empirical evidence consistent with claims of greater macroeconomic and financial integration within the GCC.

**Keywords**: GCC, Oil, Economic Growth, Economic Diversification, Labor Markets, Institutions, Natural Resource Curse, Dutch Disease.

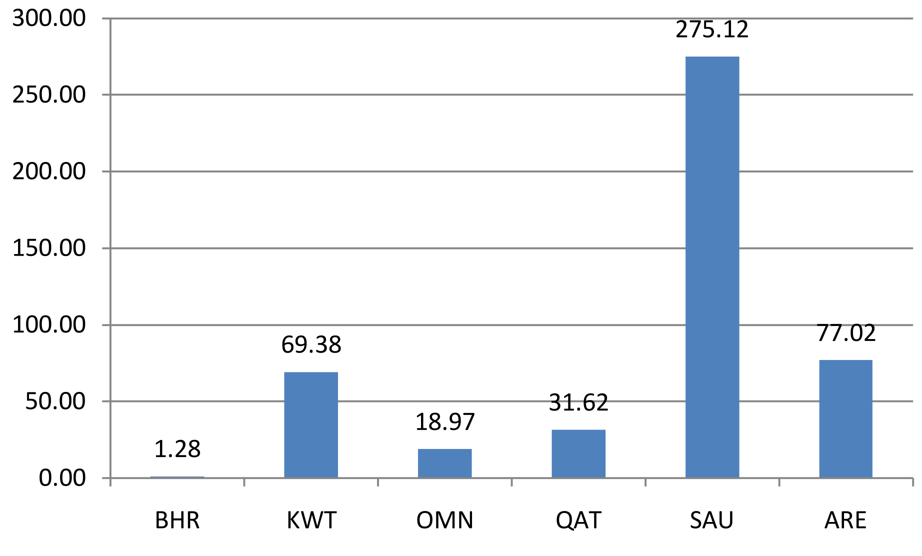
**JEL Codes**: E62, F39, O53

## 1. Introduction

In a bid to reduce their dependency on oil and natural gas revenues, GCC governments have recently invested considerable resources to diversify their economies.[1] Economies in the Gulf share a number of common features: among them, a reliance on the revenues generated from hydrocarbon reserves (see Figures 1 and 2, below) and a reliance on foreign workers who often comprise the majority of the workforce. In addition, GCC states have public sectors that employ significant proportions of the national labor force and offer a generous welfare system to their nationals.

This paper provides an empirical assessment of economic diversification in the GCC for the period 1980–2005. In particular we assess whether oil and natural gas revenues, government policies and foreign flows of labor have contributed to greater economic diversification, proxied by real growth in non-hydrocarbon GDP per worker. To our knowledge, this is the first paper that analyzes economic diversification in the Gulf using panel data techniques that explicitly treat the GCC as an economic block.[2]

Figure 1 – GDP derived from oil in 2007, in billions of current US dollars



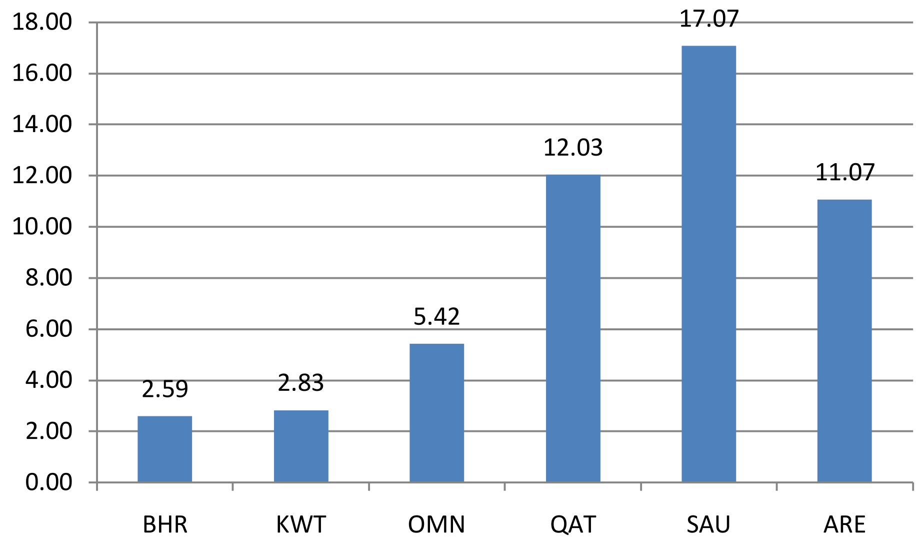

Source: Energy Information Administration, British Petroleum

[1] GCC states consist of Bahrain (BHR), Kuwait (KWT), Oman (OMN), Qatar (QAT), Saudi Arabia (SAU), and the United Arab Emirates (UAE or ARE).
[2] See literature review below.

Our empirical assessment of growth drivers in Gulf economies employs pooled mean group (PMG) estimators, as developed by Pesaran et al (1999) along with other traditional estimation techniques (mean-group and fixed effect estimators). Unlike other estimation techniques, PMG estimation allows for the treatment of GCC countries as an economic block but takes into account short-term policy divergences. We also present theoretical findings from a companion paper (Coury and Lahouel, 2009) to explain our empirical findings on the effect of labor market dynamics on growth.

Our findings suggest that the only variable that consistently explains both overall growth per worker and non-hydrocarbon growth per worker is lagged hydrocarbon GDP per worker. Government size as proxied by government final consumption has a negative and significant impact on growth per worker, and is larger in growth regressions where the dependent variable is growth in non-hydrocarbon GDP per worker. This negative impact is significantly larger than in the OECD (see section 4.2 below). Savings (as proxied by fixed capital formation as a proportion of GDP) do impact overall growth but are negatively associated with non-hydrocarbon growth. Finally, population growth does not have a significant impact on per capita growth rates, in contrast to findings from the OECD. The growth model presented in section 5 explains this result by modeling an open labor market with abundant supplies of labor. Predictions of this model are consistent with both features of labor markets in the Gulf and growth estimations.

Figure 2 – GDP derived from natural gas in 2007, in billions of current US dollars



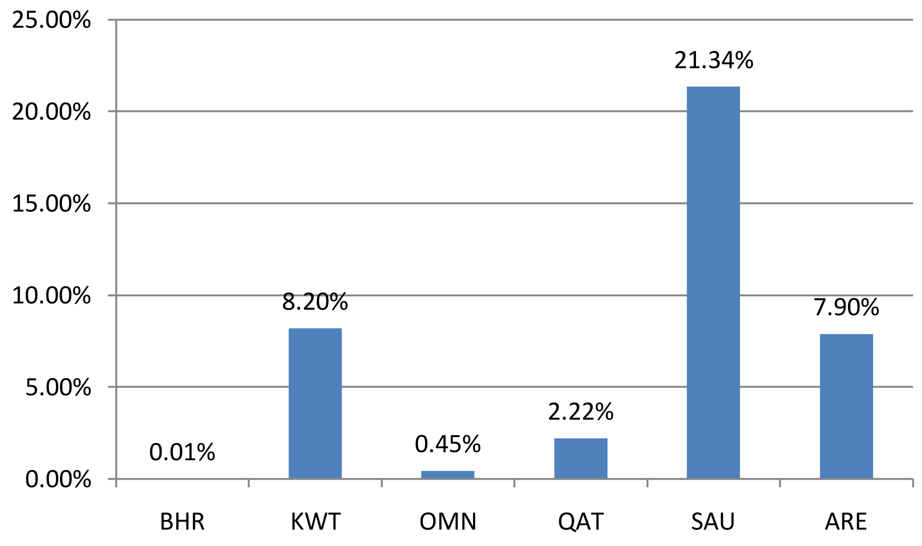

Source: Energy Information Administration, British Petroleum

While revenues from oil and natural gas are important in explaining growth patterns, the distribution of hydrocarbon reserves among the GCC countries is rather uneven: Saudi Arabia controls the bulk of oil reserves while the UAE and Kuwait are a distant second (Figure 3).[3]

In contrast, Qatar has the most significant reserves of natural gas (Figure 4). These countries have used their hydrocarbon revenues (see Table A4 in the appendix) to expand their economies; because of relatively small national populations, both the public and private sector have hired significant proportions of foreign workers. By 2005, foreign population as a percentage of the total workforce was as high as 90% for the UAE and 89% for Qatar.[4] As a proportion of the total population, it was 80% for the UAE and 83% for Qatar.[5]

No reliable time-series data exists on the proportion of the foreign population for the Gulf States.[6] Labor laws in the region however suggest that the proportion of the working population would increase in tandem with the proportion of foreign workers. Table A1 (in appendix A) indicates that the percentage of 15–64 year olds has increased for the period 1980–2005.

Figure 3 – Proved oil reserves as a percentage of world total – 2007

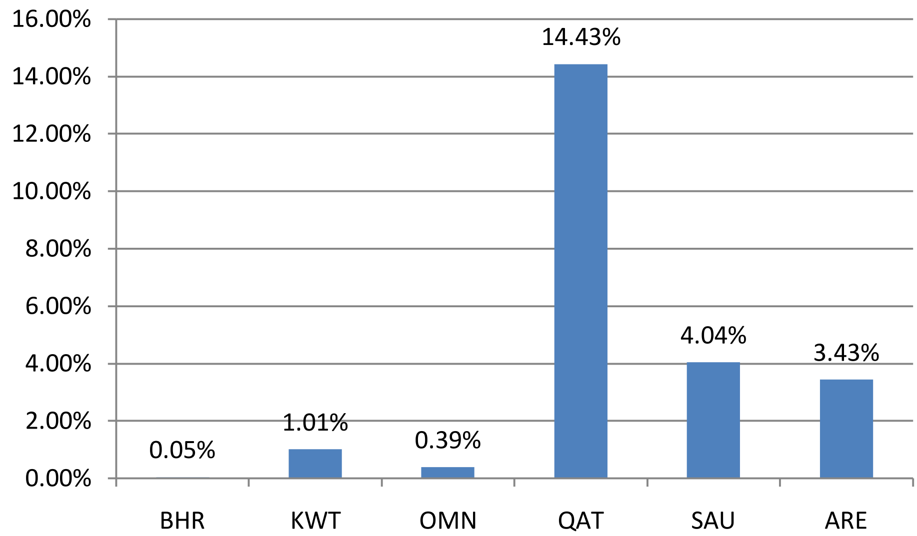



Source: Energy Information Administration, British Petroleum

[3] GCC countries, except for Bahrain and Oman, belong to the oil cartel OPEC.
[4] From Sturm et al, 2008. They also report: 59% for BHR, 81% for KWT, 33% for OMN, 47% for SAU.
[5] For other Gulf States, it was 34% for BHR, 53% for KWT, 19% for OMN, and 21% for SAU.
[6] See however the 2006 UN International Migration Report [45] for a “snapshot” comparison between 1995 and 2005.

So while hydrocarbon revenue has generated overall growth in GDP (Table A5), the increase in population has caused per capita growth to be close to zero or even negative (see Tables A2, A3, and A7). The highest (average, year-on-year) growth rate was 2.64% for Oman and the lowest was $-3.03\%$ for the UAE. Growth in non-hydrocarbon sectors has been mixed; for example the 1990s saw positive growth rates in excess of 10% for the UAE but as low as 0.88% for Kuwait (see Table A6). In per capita terms, non-hydrocarbon growth has been lackluster. For the period 1980–2005, the highest (average, year-on-year) growth rate was in excess of 2% for Kuwait and Oman but was $-0.49\%$ for Saudi Arabia, 0.36% for Qatar, 0.54% for the UAE and 0.87% for BHR (Table A8).

Figure 4 – Proved natural gas reserves as a percentage of world total – 2007




Source: Energy Information Administration, British Petroleum

Research on countries in the Mideast and North Africa highlight similar growth experiences.[7] More broadly, cross-country evidence on the negative link between natural resources revenue and per capita growth has been documented in the work of Sachs and Warner (2001).[8]

The so-called "natural resource curse" exists in the GCC to the extent that government policy and savings have a differential impact on growth per worker between the GCC and

[7] See the recently published volume of collected essays edited by Nugent and Pesaran (2007).
[8] See section 2.1 of van der Ploeg (2006) for an extensive literature review documenting the natural resource curse and related experiences.

the OECD. In particular, the impact of government consumption on growth per worker is large, negative and statistically significant and suggests substantial inefficiencies in how GCC governments allocate funding. Poor growth experiences in the GCC are also due to high growth rates in its foreign workforce. As such, the process that generates lackluster growth in the GCC may have more to do with labor market structure than the natural resource curse.

Several explanations have been advanced to explain the negative link between natural resources and growth.[9] Terms-of-trade models emphasize the worsening export competitiveness following an increase in the size of the sector driving growth – in this case, oil and natural gas – see Johnson (1955) and Bhagwati (1958). Models with a tradable and non-tradable sector emphasize the increasing demand for the non-tradable good once domestic income rises. The attendant increase in the value of the domestic currency causes the tradable goods sector to lose competitiveness. The natural resource sector, through a terms-of-trade effect, causes the tradable goods sector to suffer (Corden and Neary (1982) and Corden (1984)). Other models emphasize the impact of the resource sector on learning by doing in the non-resource sector and the subsequent effect on long-run growth (Matsuyama, 1992), the importance of transfers in increasing the real exchange rate and driving out the tradable-goods sector (Dornbush et al (1977), Krugman (1987)) and the lack of human capital accumulation in the tradable sector as a result of growth in the resource sector (Sachs and Warner (1997), Gylfason et al. (1999)). The recent work by Cherif (2008) develops and tests a model where productivity gaps in the tradable sector relative to the trade partner at the time when resources are discovered has a negative impact on long-run growth outcomes, a process he calls the “OPEC disease”. His model's predictions are consistent with empirical evidence that the growth experiences of the US and Canada are superior to those of many OPEC countries.

Political economy models mostly emphasize the competition among different groups to capture rents from natural resources (recently Guriev et al, 2009). The lack of political participation and bureaucratic concentration (Tsui (2005), Tornell and Lane (1999)), the link between resources and corruption (Leite and Weidmann, 1999), the role of civil war in capturing resources (Collier and Hoffler, 2004), and the relationship between the quality of institutions, resources and growth (Isham et al (2003), Sala-i-Martin and Subramanian (2003) and more recently Bhattacharyya and Hodler, 2009) are all thought to play a role in explaining the natural resource curse.

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[9] The following is taken in part from Chapter 3 of Cherif's dissertation (2008).

Although there is some evidence of a resource curse in the Gulf, the purpose of this paper is to assess drivers of economic diversification in the GCC with a focus on the role of foreign labor in generating growth. The paper is organized as follows. Section 2 details the empirical approach used, section 3 explains the choice of regressors, section 4 discusses the regression results, section 5 presents a modified growth model consistent with empirical findings in the labor market, section 6 considers some broader issues tying the GCC to other Mideast countries and section 7 concludes.

## 2. Empirical Approach

A number of different approaches have been used to analyze the relationship between variables in a dynamic panel of countries: one approach is to run a growth regression for each country separately.[10] The resulting average country coefficients, called mean-group (MG) estimates, can then be used to explain sources of growth for the panel, in this case the GCC. The growth equation for country $i$ takes the following form:

$$\Delta lny_{i,t} = a_{0,i} - \phi_i lny_{i,t-1} + \sum_j a_{j,i}\ ln\beta_{i,t}^{j} + \sum_j b_{j,i}\, \Delta ln\beta_{i,t}^{j} + c_i \Delta lnp_{i,t}$$

$$+d_i \Delta^2 lnp_{i,t} + e_i t + \varepsilon_{i,t}$$

Here the dependent variable, $\Delta lny_{i,t}$, is the percentage change in output per worker $y_{i,t}$ from year to year. In our case, we will consider both overall output and non-hydrocarbon output. The collection of (detrended) regressors $ln\beta_{i,t}^{1}$, $ln\beta_{i,t}^{2}$, ·· represents factors that may explain the growth process in output per worker over time. These include for example the savings rate and government spending as a percentage of overall output. The choice of regressors is explained in detail in the next section. The detrended regressors $\Delta ln\beta_{i,t}^{j}$ capture temporary fluctuations in the growth process. The coefficient $a_{0,i}$ is the slope intercept for country $i$, and $t$ is a time trend. The regressor $lny_{i,t-1}$ is lagged, detrended, output per worker and captures convergence in rates of growth over time. Finally, $\Delta lnp_{i,t}$ is the percentage change in population $p_{i,t}$ over time and $\Delta^2 lnp_{i,t}$ controls for fluctuations in rates of population growth over time.

[10] See Durlauf (2000) for a general critical assessment of growth regressions.

While this regression approach is relatively straightforward to implement in the case of the GCC, it ignores that these states share a number of similar features. In addition to geography, language and natural resources, the GCC states share broadly similar forms of government and claim joint political objectives. The latter have made been made explicit in the creation of the Gulf Cooperation Council in 1981[11]. These common features should somehow be included in the empirical exercise.

While the MG approach allows coefficients associated with growth regressors to be different across countries, the fixed effects (FE) approach forces homogeneity of coefficients but allows for country-specific coefficients to differ. The underlying assumption of the FE approach is that countries in the panel are subject to the same economic forces in all time periods. While estimating the above equation for individual countries does not exploit cross-country differences in growth experiences, the FE approach of constraining all coefficients to be the same may result in a severe heterogeneity bias in the case of the Gulf States. While the GCC have some common features that would explain their long-run growth, short-run differences in policy objectives may introduce short-run heterogeneity in their growth patterns.[12]

While we report MG and dynamic FE (DFE) estimators, our analyses of economic growth in the GCC will rely primarily on pooled mean group (PMG) estimators as developed by Pesaran et al (1999). This novel approach allows for a middle ground between the MG and FE approaches. The pooled mean group approach forces selected long-run coefficients to be the same across countries in the dynamic panel, but allows short-run coefficients to differ. As a result, the heterogeneity bias in the estimation of long-run growth regressors in the FE approach is attenuated. The PMG approach has been used successfully in explaining growth experiences in OECD countries by Bassanini et al (2001) and Bassanini and Scarpetta (2002). A PMG growth regression takes the following form:

$$\Delta lny_{i,t} = a_{0,i} - \phi_i \left( lny_{i,t-1} - \sum_j a'_j \; ln\beta_{i,t}^j \right) + \sum_j b_{j,i} \, \Delta ln\beta_{i,t}^j$$

$$+c_i \Delta lnp_{i,t} + d_i \Delta^2 lnp_{i,t} + e_i t + \varepsilon_{i,t}$$

[11] The GCC charter and Economic Agreement are available at http://www.gcc-sg.org .
[12] See the discussion in Pesaran and Smith (1995).

This particular growth equation constrains all long-run coefficients to be the same across groups in the panel, except for population growth. The assumption of a common trend for population growth is rejected by a Hausman test. The assumption of long-run homogeneity may also be unreasonable for some other growth regressors. In this case, the PMG growth regression would take the form:

$$\Delta lny_{i,t} = a_{0,i} - \phi_i \left( lny_{i,t-1} - \sum\nolimits_{j\epsilon J} a'_j \; ln\beta^j_{i,t} \right) + \sum\nolimits_{k\epsilon K} a_{k,i} \; ln\beta^k_{i,t} + c_i \Delta lnp_{i,t}$$

$$+ \sum\nolimits_{j\epsilon J \cup K} b_{j,i} \, \Delta ln\beta^j_{i,t} + d_i \Delta^2 lnp_{i,t} + e_i t + \varepsilon_{i,t}$$

Here, regressors in set $J$ are constrained while those in set $K$ are allowed to differ in the long-run across countries. As explained in section 4, we will typically constrain only savings and government expenditure to be the same across countries in the long-run.

## 3. The Choice of Regressors

The selection of regressors is guided by the insights of the Solow growth model (Solow, 1956), a central contribution toward explaining the economics of growth. The Solow model aims to explain how output per worker changes over time. It assumes a production function of the type $Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$, which displays decreasing marginal returns to capital $K_t$ and labor $L_t$. The production function is assumed to be constant returns to scale and yields a level of output$Y_t$. The term $A_t$ represents Total Factor Productivity (TFP) and captures all factors that contribute to output $Y_t$ that are not capital or labor. TFP growth for example includes advances in technology and also advances in the quality of institutions.

The domestic population is assumed to save a proportion $s$ of output in each period for the purposes of investment. This yields a capital accumulation equation of the form $\dot{K} = sY - \delta K$ where $\delta$ is the rate of depreciation of capital and $\dot{K}$ is the instantaneous change in overall capital over (a small period of) time. Assuming population grows from one period to the next at a rate $n$, we obtain the following equation expressed in per worker terms: $\dot{k} = sAk^{\alpha} - (\delta + n)k$ where $k$ is capital per worker and $k^{\alpha}$ is production per worker. As capital grows, decreasing marginal returns imply that capital per worker reaches a steady state $k$ which satisfies $sAk^{\alpha} = (\delta + n)k$.

Low levels of initial capital imply higher levels of output growth per worker – this means in particular that economies are believed to display convergence in the long-run – higher levels of population growth imply lower levels of output per worker in the steady state and slower growth rates of output per worker along the transitional dynamics. Finally, higher savings rates imply higher output per worker in the steady state and higher growth rates along the transitional dynamics.

For the purposes of our empirical estimation and depending on the regression specification, we use two different kinds of dependent variables. They are

- The percentage change in output per worker $\Delta ln\, y$ where $y = Y/p$. $Y$ is PPP-adjusted output in constant 2005 dollars and $p$ is population aged 15–64. The number of workers is proxied by the number of workers in this age bracket. Output $Y$ is PPP-adjusted to allow for international comparisons.[13]

- The percentage change in non-hydrocarbon output per worker $\Delta ln\, y'$ where $y' = Y'/p$. $Y'$ is non-hydrocarbon output, PPP-adjusted. $Y'$ is computed using overall output net of oil output and natural gas output. We use data from the BP online database to compute the last two quantities.

The predictions of the Solow growth model guide our choices of independent variables used in baseline regressions.

- The rate of physical capital accumulation $ln\, s$ ($ln\, s'$). Here, $s = S/Y$ and $s' = S/Y'$ where $S$ is gross fixed capital formation in current dollars. Here, $Y$ ($Y'$) is output (non-hydrocarbon output) in current dollar terms.[14]

[13] All data is taken from the following online sources: the World Bank, the International Monetary Fund, British Petroleum and the Energy Information Administration.
[14] World Bank definition: gross fixed capital formation includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.

- Oil and natural gas revenue $ln\, r_{-1}$. This is lagged hydrocarbon GDP per worker, in PPP-adjusted terms. Here, $r = R/Y$ where R equals hydrocarbon revenue, PPP-adjusted.

- Government spending $ln\, g(ln\, g')$ where, $g = G/Y$ and $g' = G/Y'$. $G$ is general government final consumption expenditure in current dollars. Here, $Y$ $(Y')$ is output (non-hydrocarbon output) in current dollar terms.[15]

- The rate of growth of the working age population $\Delta ln\, p$. We use the rate of growth of the proportion of the population between the ages of 15 to 64 to proxy this measure.

- A convergence regressor $ln\, y_{-1}(ln\, y'_{-1})$. This is lagged, PPP-adjusted, output per worker (non-hydrocarbon output per worker). Here, $y = Y/p$ and $y' = Y'/p$.

- A time trend $t$.

We do not include a measure of TFP growth in our regressors. The assumption of a common TFP process for Gulf States is plausible as they are small open economies. Instead, we include a time trend in all regression specifications.[16]

Due to data limitations, we also do not include any measure of human capital stock, proxied for example by educational attainment. According to a recent 2008 report by the World Bank[17], the Middle East region has made substantial progress in increasing levels of education since the 1960s, but these better educational outcomes do not seem to translate into economic growth. The report suggests wide variations in government spending on

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[15] World Bank definition: general government final consumption expenditure includes all government current expenditures for purchases of goods and services (including compensation of employees).
[16] See chapter 6 of Jones (2002) for a justification of this approach.
[17] "The Road Not Travelled: Education Reform in the Middle East and Africa", World Bank (2008).

education in the Gulf, and World Bank data[18] suggest wide variations across Gulf States in enrollment ratios from primary to tertiary education.

The economic growth literature however highlights the importance of education and human capital in generating growth: in a cross-section study conducted for 98 countries, Barro (1991) shows a positive link between per capita output growth in the period 1960–1985 and initial human capital as proxied by 1960 school enrollment rates. Later papers by Lee (1993, 2000) show a positive link between secondary school education and growth.

Much of the workforce in the GCC are not nationals so a link between growth and education of GCC nationals is more difficult to uncover. Measures of human capital growth would require data on educational outcomes for nationals, education data for the non-national population, and the proportion of nationals to non-nationals. For the purposes of our regression analysis, it is not clear that any proxy for the human capital stock in the GCC would display long-run homogeneity. Thus, we allow the PMG estimator for the time trend to remain unconstrained in the long-run.

## 4. Estimation Results

If the assumption of slope homogeneity is correct, PMG estimates are both efficient and consistent. This assumption, however, may not always hold. If the true data-generating process yields heterogeneous long-run coefficients, then PMG estimates are inconsistent. MG estimates, on the other hand, are always consistent. We therefore report the Hausman test to see whether the assumption of slope homogeneity is rejected, in addition to PMG, MG and DFE estimates for all regression specifications (see appendix B). We also report the joint Hausman test statistic whenever it is applicable and can be computed. Our regressions frequently exclude Qatar from the estimation exercise: this is because data on savings (proxied by fixed capital formation) and government expenditure (proxied by government final consumption) is not publicly available before 1992.

We report on two broad set of regression specifications. The "baseline" estimations include independent variables derived in part from the Solow growth model. These variables are savings, government expenditure, population growth, a convergence coefficient, a time

[18] The World Bank Educational Statistics available at www.worldbank.org/education/edstats

trend, and lagged hydrocarbon GDP per worker. The dependent variable is either overall growth in GDP per worker or growth in non-hydrocarbon GDP per worker. Results are reported in Tables B1–B8. The “extended” estimations include independent variables related to macroeconomic performance that are generally thought to affect per capita output growth but are not variables in the Solow growth model. These additional independent variables are inflation, exports, imports and two measures of financial development. Regression results are reported in Tables B9–B12.[19]

## 4.1 Slope Homogeneity and Convergence

We first consider the validity of the slope homogeneity assumption in our baseline regressions. When the dependent variable is growth in overall GDP per worker ($ln\, y$), a joint Hausman test rejects joint long-run homogeneity of $ln\, s$ and $ln\, g$, savings and government spending when Qatar is excluded from the sample (Table B1) while individual long-run homogeneity is not rejected when each individual variable is constrained while the other is not (Tables B2 and B3). When Qatar is included in the sample, the assumption of joint homogeneity is also rejected (Table B4). In addition, the assumption of homogeneity in savings is also rejected (Table B5) while the assumption of government expenditure homogeneity is not (Table B6). When the dependent variable is growth in non-hydrocarbon per worker ($ln\, y'$), joint homogeneity of savings and government expenditure (this time, as a proportion of non-hydrocarbon output, and controlling for hydrocarbon revenue) is not rejected when Qatar is excluded from the sample (Table B7) and rejected when Qatar is included (Table B8).

For the purposes of regression analysis, we adopt the assumption of long-run homogeneity of both savings and government spending when the dependent variable is non-hydrocarbon growth $ln\, y'$. In the extended analysis, we include the following additional regressors.

- Inflation, $inf$. This is the annual percentage change in the consumer price level, year-on-year.

[19] PMG estimates for individual countries are not reported due to space considerations. They are available upon request.

- Exports as a proportion of output, $ln\ ex'$. Here, $ex' = EX/Y'$ where $EX$ corresponds to exports of goods and services in current dollars and $Y'$ is non-hydrocarbon GDP, also in current dollars.

- Imports as a proportion of output, $ln\ im'$. Here, $im' = IM/Y'$ where $IM$ equals imports of goods and services in current dollars.

- Domestic credit provided by banking sector as a proportion of non-hydrocarbon output, $ln\ cr_1'$ where $cr_1' = CR_1/Y'$ and $CR_1$ is overall domestic credit provided in current dollars.[20]

- Domestic credit to private sector, as a proportion of non-hydrocarbon output, $ln\ cr_2'$ where $cr_2' = CR_2/Y'$ and $CR_2$ is overall domestic credit to private sector in current dollars.[21]

When the dependent variable is growth in non-hydrocarbon GDP per worker, a joint Hausman test does not reject long-run homogeneity of savings, government expenditures and inflation (Table B9 – Qatar is excluded). The Hausman test does not reject long-run slope homogeneity for these variables when they are all restricted to be the same and when other (unrestricted) variables are included such as exports and imports (Table B10), and domestic credit variables (B11 and B12).

The estimated convergence coefficient in all PMG and DFE specifications of the regression is negatively signed, and statistically significant. This result is consistent with the predictions of the Solow growth model. The latter predicts that higher initial levels of output, which correspond to higher levels of the capital to labor ratio, should be associated with lower subsequent rates of economic growth. This convergence result has been widely documented in the traditional growth literature.[22]

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[20] World Bank definition: Domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net.

[21] World Bank definition: Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises.

[22] See chapters 2 and 3 of Jones (2002) for an overview of empirical applications of the Solow's model.

## 4.2 Discussion

The purpose of the growth regressions reported in appendix B is to determine which factors have the greatest influence in generating long-run growth of output per worker. The focus of our regressions is on non-hydrocarbon output per worker. While these growth regressions cannot pinpoint which sectors are contributing most to economic diversification, they are helpful in explaining whether government policy and other factors are in fact helping to achieve economic diversification.

We have two explanatory variables related to government policy. They are $ln\ g$ ($ln\ g'$) and $inf$. The former ($ln\ g$) is detrended government spending as proxied by government final consumption. When the dependent variable is $ln\ y$, the estimated coefficient associated with $ln\ g$ is always negative and frequently statistically significant at the 1% level (see Tables B1–B7). From the previous section and appendix B, Tables B3 and B6 are most appropriate in our baseline specification. They show that PMG estimates of the $ln\ g$ coefficient is negative and significant at the 1% level and equals $-.182$ and $-.282$ depending on whether Qatar is included or excluded from the sample, respectively. These numbers mean that, controlling for other factors, a 1% increase in government spending as a proportion of overall output is associated with a decrease in output growth per worker of somewhere between 18.2% and 28.2%, controlling for the other independent variables. When the dependent variable is $ln\ y'$ (non-hydrocarbon output growth per worker), the estimated coefficient for independent variable $ln\ g'$ is $-1.023$ and statistically significant at the 1% level.

Overall our baseline regressions suggest that government expenditures by Gulf States do not seem to be generating growth in either overall output or non-hydrocarbon output per worker. In our extended regressions, we find that the estimated coefficient for $ln\ g'$ is also negative for all specifications (Tables B7–B12) and significant at the 1% level in all specifications, except for B11. The smallest estimate (in magnitude) is $-0.809$. This negative impact of government spending in the Gulf States is in contrast to the neutral or sometimes positive impact of government spending in OECD countries as reported in Bassanini et al (2001). That government spending is not actually generating a more diversified economy suggests substantial inefficiencies in the way Gulf States have allocated funding for the period 1980–2005 and is consistent with both economic and political economy models of the natural resource curse, as cited in the introduction.[23]

[23] See also Alesina and Tabellini (2005) linking sub-optimal fiscal policy to political distortions.

When the dependent variable is $ln\, y$, estimated coefficients associated with savings ($ln\, s$) is either positive and significant at the 1% level or not significant (Tables B1–B6). In contrast, when the dependent variable is $ln\, y'$ (non-hydrocarbon GDP growth per worker), the estimated coefficient associated with savings as a proportion of non-hydrocarbon GDP ($ln\, s'$) is negative for all regression specifications B7–B12 and significant, except B8. This is in contrast to OECD estimates[24] and to the prediction of the Solow model.

Not surprisingly, oil and natural gas GDP is an important source of economic growth among GCC countries. When the dependent variable is $ln\, y$, the effect is positive but insignificant (B1–B6). When the dependent variable is $ln\, y'$, the estimated coefficient attached to $ln\, r$ is positive (except for B8) and significant (except for B10). Among all explanatory variables, lagged hydrocarbon GDP per worker is the one most consistently associated with growth in the non-hydrocarbon sectors. From the baseline estimation in B7, we have the following PMG estimates attached to lagged hydrocarbon GDP per worker: $0.1461$ for BHR, $1.6617$ for KWT, $0.9562$*** for OMN, $0.3455$** for SAU, and $0.3123$*** for the UAE.[25]

Among our measures of economic performance, we include inflation and consider its effect on non-hydrocarbon growth. We find that the PMG estimate is negative and significant at the 1% level in all regression specifications (Tables B9–B12). The range of the estimates is between $-1.019$ and $-1.71$. In comparison, Bassanini et al (2001) report an estimate of $-0.01$ for OECD countries. Currencies in the Gulf are (essentially) pegged to the US dollar, while OECD countries have floating currencies. Many OECD countries' monetary policy is used to stabilize certain economic aggregates like inflation and output gaps. Because currencies in the Gulf are pegged, the monetary instrument cannot be used to achieve stable rates of inflation. These estimates may be interpreted as the cost on economic growth of having a fixed exchange rate.

Other factors, however, contribute to inflation and inflation volatility that may not be related to the currency pegs. For example, the real-estate boom witnessed in parts of the Gulf (and preceding the current economic crisis) has contributed to inflationary pressures; oil prices have contributed to inflation volatility. This negative impact, a fortiori, may best be viewed as the "accounting cost" of inflation rather than its "economic cost": the regression results do not tell us whether the counterfactual (floating the currency and, say, targeting inflation) would yield better growth outcomes than the current monetary regime. Since targeting inflation requires a greater level of institutional development, a currency peg may

[24] See Bassanini and Scarpetta (2002) and Bassanini et al (2001).
[25] *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

be the right (second-best) policy for the Gulf States.[26] In addition, a counterfactual monetary arrangement may generate greater volatility in the finances of GCC governments since oil is currently traded in US dollars.

Controlling for inflation and lagged hydrocarbon revenue, the remaining regressions show that neither exports, imports or financial development (as measured by our variables $ln\ cr_1'$ and $ln\ cr_2'$) have any significant impact on growth in non-hydrocarbon GDP per worker.

As noted in section 4.1, the assumption of joint long-run homogeneity of savings, government spending and inflation is not rejected by a Hausman test. This is consistent with claims that Gulf Cooperation Council economies are becoming more integrated.

Finally, population growth (more precisely, growth in the working population, as proxied by the proportion of 15–64 year olds) frequently has a negligible impact on output growth per worker. For example, when the dependent variable is $ln\ y$, all PMG estimates in B1–B7 are not significant, except for B2, B4, and B6 where the estimates are positive and significant. When the dependent variable is $ln\ y'$, PMG estimates of $\Delta ln\ p$ are not significant, except for B10, where the estimate is negatively signed and significant at the 10% level. These results are in stark contrast to similar estimations for the OECD, where the estimate is almost always negative and significant.[27] A negative impact is predicted by the Solow growth model: higher growth rates in population lead to smaller levels of per capita output in the steady state and lower growth rates along the transitional dynamics. Since the PMG estimate for population growth is not constrained to be the same across countries, the estimates listed in appendix B are simply country averages. In the baseline estimation reported in Table B7 for example, population growth has the following impact on individual countries: negative and not significant for BHR, KWT, OMN, SAU, but positive and significant at the 1% level for ARE. In the next section, we explain how particular features of labor market dynamics in the Gulf may explain these results.

## 5. Employment and Growth

While substantial foreign labor flows have been at the centre of the burgeoning economies in the Gulf, their role in promoting economic growth is poorly understood. The labor market

[26] More generally, see the working paper by Rodrik (2009).
[27] See Bassanini and Scarpetta (2002) for baseline estimates.

structure in the Gulf is, in many ways, a radical departure from labor markets found in OECD countries. Predictions of the Solow growth model rely on assumptions of perfect competition in labor and capital markets, and diminishing marginal returns to factors of production – assumptions that may not be applicable in the Gulf. In this section, we focus on how the shape of the foreign labor supply curve results in a "reduced form" production function that features constant marginal returns to capital. The predictions of this modified model are more consistent with the observed effects of population growth on growth per worker than the standard Solow model.

An important feature of the labor market for foreign workers in the Gulf has to do with the large pool from which domestic firms can choose workers. In some sectors, especially those employing unskilled labor, a typical domestic firm can always hire a sufficient number of foreign workers at the prevailing wage rate. This hiring is facilitated by "pro-business" labor laws. This is in contrast to labor market arrangements in many OECD countries where firms must hire, at least in the first instance, from the local pool of workers. Under these conditions, domestic firms that wish to expand have to eventually increase wages in order to attract a larger pool of workers. In the Gulf, the situation is markedly different: as a firm expands, it hires more workers without having to increase the prevailing wage rate.

Domestic firms engaged in construction and other labor-intensive activities in the Gulf tend to hire their workers from India, China and other developing countries. The difference in the population size of the GCC relative to these countries ensures that Gulf firms will always have access to cheap labor. More importantly, the labor supply schedule that Gulf firms face is likely to be "flat" for relevant levels.

For the purposes of our baseline growth model[28], we will assume that all workers can be hired at an exogenous wage rate $w_t$ in period $t$. In addition, we assume that this exogenous wage rate is not affected by the level of labor demand. This means that $w_t$ is also the equilibrium wage rate. This may not be the only distortion that Gulf labor markets face, a point to which we shall return at the end of this section. The following growth model illustrates the growth implications of assuming that all firms hire workers at an exogenous rate; the model in turn sheds some light on the actual growth dynamics in the Gulf.

[28] This model builds on the current work by Coury and Lahouel (2009). A modern and related treatment of the effects of labor migration on growth is available in Braun (1993) and also discussed in chapter 9 of Barro and Sala-i-Martin (2004).

As in the Solow model, we assume that production takes a familiar Cobb-Douglas specification of the form $Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$.[29] Wages are given exogenously by a stream $w_t$ and the firm hires workers until the marginal product of labor equals the wage rate:

$$\boldsymbol{w_t = \frac{\partial Y_t}{\partial L_t} = (1-\alpha) A_t K_t^{\alpha} L_t^{-\alpha}} \qquad \mathbf{1}$$

Labor demand in period t is therefore given by:

$$\boldsymbol{L_t = \left(\frac{(1-\alpha)A_t}{w_t}\right)^{\frac{1}{\alpha}} K_t} \qquad \mathbf{2}$$

Because labor is supplied perfectly elastically at this wage rate, there is sufficient labor supply $L_t^s$ to equal labor demand, given in the above expression. The capital accumulation equation is given, as in the Solow model, by $\dot{K} = -\delta K + sY$, where $s$ is the savings rate in the economy and $\delta$ is the instantaneous rate of depreciation of capital. Using the above expression for labor demand, we obtain the following equation describing the dynamics of the growth rate of capital per worker:[30]

$$\boldsymbol{\frac{\dot{k}}{k} = \frac{1}{\alpha}\left(\frac{\dot{w}}{w} - \frac{\dot{A}}{A}\right)} \qquad \mathbf{3}$$

The term $\dot{k}/k$ is the percentage change of capital per worker over a period of time; $\dot{w}/w$ is the rate of change of wages over time and $\dot{A}/A$ is the rate of change of total factor productivity. To explain this equation, note that an exogenous fall in wages causes domestic firms to hire more workers so the existing stock of capital per worker falls. Greater TFP growth causes a typical firm to hire more workers (see equation 2) causing existing capital stock per worker to fall.

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[29] The effects of population growth are about the same (insignificant) in specifications where the dependent variable is $ln\ y$ or $ln\ y'$. Output $Y_t$ in this section is best thought of as non-hydrocarbon output, instead of overall output: except for BHR and OMN, Gulf States belong to the oil cartel OPEC.

[30] We consider variables per worker instead of variables per capita. If the working population is in constant proportion to the overall population, resulting growth rates will not be affected. In economic growth terms, we will observe scale rather than growth effects.

Notice that the overall production function now takes the following reduced form:

$$\boldsymbol{Y_t = A_t^{\frac{1}{\alpha}} \left(\frac{1-\alpha}{w_t}\right)^{\frac{1-\alpha}{\alpha}} K_t} \qquad \mathbf{4}$$

The growth model associated with this production function is the so-called AK model and is the simplest incarnation of an endogenous growth model.[31] We now combine equations 2 and 4 to solve for the level of output per worker $y = Y/L$ in the domestic economy:

$$\boldsymbol{y_t = \frac{w_t}{1-\alpha}} \qquad \mathbf{5}$$

Therefore, the rate of economic growth in per worker terms can be expressed as follows.

$$\boldsymbol{\frac{\dot{y}}{y} = \frac{\dot{w}}{w}} \qquad \mathbf{6}$$

The conclusions reached by this modified economic growth model are quite different from those of the standard Solow growth model. For example, the model does not allow for convergence of output per worker.

Notice also that labor supply does not have the usual effects on growth per worker. In the Solow growth model, an exogenous increase in the population growth rates causes capital per worker (and therefore output per worker) to permanently fall to a lower steady state level. This prediction is validated in growth regressions for OECD countries but not in the case of Gulf States. In this modified model, an increase in the (foreign) population would come about either because of lower exogenous wages, increases in TFP or increases in capital formation. Indeed, the dynamic version of equation 2 takes the following form:

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[31] Textbook treatment of endogenous growth and the AK model can be found in Jones (2002), and Barro and Sala-i-Martin (2004) among others.

$$\frac{\dot{L}}{L} = -\frac{1}{\alpha}\frac{\dot{w}}{w} + \frac{1}{\alpha}\frac{\dot{A}}{A} + \frac{\dot{K}}{K} \qquad \mathbf{7}$$

If the growth rate of wages falls, it would tend to increase population growth which would dilute existing capital stock and cause output per worker to fall. This is captured in equation 5. This results in a negative relationship between output per worker and population growth, mirroring the results in the Solow growth model. But as equation 6 illustrates, other things might cause population growth to change. For example, TFP growth causes higher labor demand but since labor grows linearly with the capital stock (see equation 2), output per worker is not affected. In the absence of shocks to the growth of TFP or wage rates, labor accumulates linearly with the capital stock. Population growth of this kind however does not impact output per worker.

Which factor is likely to dominate for Gulf States? While further analysis is required, one presumes that real wage growth (as captured by $\dot{w}/w$) is minimal since firms in the Gulf have access to a vast pool of poor and unskilled foreign workers. As a result, it is unlikely that the link between population growth and output per worker is likely to manifest itself through wage growth. On the other hand countries in the Gulf have benefited from both technological progress and better institutions; both components in TFP. The latter affects population growth but not output per worker. Finally, capital accumulation is "accommodated" by population growth but, again, does not affect output per worker. Although the foreign workforce in the Gulf constitutes only a proportion of the overall workforce, this model captures some aspects of the growth experience in the Gulf, and in particular why population growth has an insignificant effect on growth rates of output per worker.

Domestic firms facing a perfectly elastic labor supply is a simplifying assumption. GCC economies do not rely solely on unskilled foreign labor. The presence of a small number of firms in comparison to the large pool of foreign labor, along with pro-business labor laws, suggests that firms may not be acting competitively in the labor market.[32]

This feature of the labor market structure is developed in a growth model by Coury and Lahouel (2009); the idea that workers get paid a subsistence wage rather than their marginal product dates back to William Arthur Lewis's (1954) analysis of the impact of "unlimited supplies of labor" on economic development. While the model presented in this

[32] See the 2009 UN Human Development Report for a discussion of laws directed toward migrants in a selection of countries.

section predicts "instantaneous" convergence to steady-state levels of output per worker (in contradiction with our empirical findings), the growth model in Coury and Lahouel (2009) allows for transitional dynamics to a steady state, low growth rates in output per worker along the transitional dynamics as compared with the Solow growth model and high growth rates in overall output; consistent with both local labor laws and "stylized facts" of growth experiences the Gulf.[33]

## 6. The GCC in the Middle East

TFP growth has no impact on growth in output per worker in the modified growth model of the preceding section: positive TFP growth causes firms to hire more workers, diluting the current stock of capital per worker. At the same time, output per worker increases as firms become more productive. The model however predicts that both of these effects cancel each other out. While our growth regressions do not test directly for the effects of TFP growth, the estimated coefficients attached to the population growth regressor are consistent with the modified growth model.

In related research on the MENA region[34], Fattah et al[35] perform a GDP growth rate decomposition for the period 1960–1997 and find that TFP growth has little effect on MENA economic growth with the exception of Egypt, Morocco, Tunisia and Turkey. They also perform Barro-type growth regressions and find evidence of a natural resource curse in MENA resource-rich countries that is more pronounced than in non-MENA resource-rich countries. They also find that, when compared to the rest of the world: capital is less efficient, trade openness is less beneficial to growth, the impact of negative external shocks is greater, and output volatility is more detrimental to economic growth.

The growth regressions presented in this paper stress the importance of physical capital accumulation on growth performance in the Gulf. In turn, the economic growth model of the preceding section provides a rationale for the effects of physical capital accumulation on growth: an increase in capital (resulting from savings) causes labor to rise but since the labor supply curve is flat, wages do not rise and labor rises proportionally with capital. As a result, the reduced-form aggregate production function is linear in physical capital (it is of the AK form). Because overall output does not exhibit diminishing returns to capital, physical

[33] Their model relates to the growth models of Harrod (1939) and Domar (1946).
[34] In addition to the GCC and Iran, the World Bank classification for MENA consists of Algeria, Djibouti, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Syria, Tunisia, and Yemen.
[35] Chapter 2 of Nugent and Pesaran (2007): "Determinants of growth in the MENA countries."

capital accumulation will impact output growth to a greater extent than in the standard growth model.

Abu-Qarn and Abu-Bader (2007) have estimated a Cobb-Douglas production function for a selection of MENA countries using cointegration and panel data methods. They find that the share in total output of payments to capital was much higher than the usual 0.3–0.4 range. They conclude that growth is mostly driven by accumulation of physical capital and increases in the levels of human capital. In addition, using a growth accounting exercise, they find that TFP has either no effect or a negative effect on per capita output growth. Overall, their results are consistent with both our growth regressions and the theoretical model presented in the preceding section.[36]

In addition to contributing to economic growth in the Gulf, foreign workers contribute to some aspects of economic development in their countries of origin. Using aggregate cross-country data, Adams and Page (2003) analyze trends in growth, poverty and inequality in MENA countries. They find that MENA countries have achieved very low levels of poverty (2% of the overall population on average) despite their poor growth performance in the recent past. In addition, they find that MENA countries are the most equal in terms of output inequality relative to other developing countries.

Their regression analysis finds that both remittances from workers abroad and public sector employment are negatively correlated with poverty. They report international remittances in the Mashreq equal to about 8–14% of GDP for the period 1977–1993. The figure for the Maghreb for the same period is between 2–4% of GDP. In their host countries, these foreign workers have created particular social and natural security challenges. Overall, recent trends in labor migration policies in the Gulf have been driven, at least in part, by these migration patterns.[37]

[36] The procedure used by Abu-Qarn and Abu-Bader (2007) assumes perfect competition in the capital and labor markets. This assumption may not be suitable for many countries in MENA.
[37] See for example Richards and Waterbury (2008), chapter 15. See also the 2009 UN Human Development Report (2009).

## 7. Concluding Remarks

This paper provides an empirical assessment of economic diversification in the GCC for the period 1980–2005. The focus of our empirical work is on the determinants of growth in non-hydrocarbon GDP per worker – our measure of economic diversification. This focus reflects the perception that Gulf States should move away from their dependence on hydrocarbon revenue.

We report pooled mean group (PMG) estimates following a technique developed by Pesaran et al (1999). PMG estimation forces homogeneity of selected long-run coefficients but allows short-run coefficients to differ across countries. The estimation procedure is a middle-ground between panel data techniques which force homogeneity of coefficients both in the long-run and the short-run, and pure time-series techniques which allow coefficients to differ across countries for all time horizons. Given that Gulf States share common characteristics, the PMG procedure takes into account that some explanatory variables are likely to have a common impact on output growth in the long-run. We also report mean group, and dynamic fixed effects estimators, for comparison. To our knowledge, this is the first study of economic diversification in the Gulf that explicitly takes into account the GCC as an economic block.

We find that lagged hydrocarbon revenue is the one explanatory variable that is most consistently associated with non-hydrocarbon growth per worker. In contrast, the impact of government expenditure in the GCC on non-hydrocarbon growth is typically negative, large, and highly significant. In OECD countries, Bassanini et al (2001) also find a negative relationship between government consumption and growth but the estimated coefficient is much smaller (see their table 5). In other regression specifications, they find a neutral or positive relationship between government consumption and growth. The results in this paper are closer to realities of countries in the MENA region[38] and suggest substantial inefficiencies in how GCC states allocated government funding for the period 1980–2005. We also find a negative, long-run impact of inflation on growth: this result may be viewed as a cost associated with GCC countries pegging their currencies. This cost however does not reflect counterfactual monetary arrangements, as explained in section 4.2.

The paper also considers the role of labor markets in shaping economic outcomes in the GCC. In our empirical section, we find that growth in the working population (as measured

[38] See for example Fattah et al (chapter 2 of Nugent and Pesaran, 2007).

by the proportion of 15–64 year olds) typically has an insignificant impact on both growth in overall output per worker and growth in non-hydrocarbon output per worker. This is in contrast to regression results from OECD countries where population growth has a negative and significant impact on output growth.

To explain this finding, we present a baseline growth model developed in a companion paper by Coury and Lahouel (2009). This model's main assumption is that the labor supply curve is perfectly elastic. This labor supply models the reservation wage rate for foreign workers. Because wages don't rise with employment, labor supply "accommodates" changes in physical capital linearly: as a result, the reduced form production function displays constant marginal returns to capital. As employment rises with capital, growth in output per worker remains stable and close to zero. This modified growth model is consistent with PMG estimates of the population growth regressor and explains a novel aspect of economic growth in economies with open labor markets and abundant supplies of labor.[39]

Finally, we find that the assumption of joint long-run homogeneity of savings, government spending and inflation is not rejected in the data. This empirical evidence is consistent with claims of greater macroeconomic and financial integration within the GCC.

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[39] It may therefore also be useful in explaining economic performance in other countries where labor supply is abundant. See for example chapter 7 of Nugent and Pesaran (2007): "Sources of economic growth and technical progress in Egypt."

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## 9. Appendix A: Tables

Table A1 — Population ages 15 — 64 as a percent of total

| | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|
| BHR | 60 | 66 | 66 | 67 | 68 | 70 |
| KWT | 57 | 61 | 62 | 66 | 72 | 74 |
| OMN | 51 | 53 | 53 | 56 | 60 | 63 |
| QAT | 65 | 70 | 71 | 72 | 72 | 78 |
| SAU | 53 | 54 | 56 | 56 | 58 | 61 |
| ARE | 70 | 69 | 69 | 70 | 73 | 78 |

Source: World Bank

Table A2 – Total Population

| | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|
| BHR | 316,711 | 386,605 | 459,716 | 544,643 | 621,618 | 695,192 |
| KWT | 1,218,282 | 1,592,611 | 1,958,000 | 540,000 | 2,027,000 | 2,396,417 |
| OMN | 1,067,780 | 1,390,310 | 1,716,360 | 2,047,241 | 2,318,235 | 2,525,751 |
| QAT | 200,023 | 305,145 | 431,260 | 504,817 | 568,177 | 731,512 |
| SAU | 8,544,197 | 11,487,483 | 15,080,265 | 17,503,373 | 19,911,068 | 22,054,283 |
| ARE | 820,640 | 1,255,630 | 1,674,476 | 2,179,646 | 2,900,316 | 3,778,838 |

Source: World Bank

Table A3 — Average of y/o/y population growth rate in preceding 5 years[40]

| | 1985 | 1990 | 1995 | 2000 | 2005 | Average |
|---|---|---|---|---|---|---|
| BHR | 4.37% | 3.48% | 3.52% | 2.87% | 2.28% | 3.07% |
| KWT | 5.89% | 4.21% | -16.96% | 47.80% | 3.35% | 2.64% |
| OMN | 5.45% | 4.62% | 3.64% | 2.82% | 1.78% | 3.37% |
| QAT | 8.04% | 8.15% | 3.83% | 2.22% | 4.43% | 5.11% |
| SAU | 6.07% | 5.80% | 3.39% | 2.79% | 2.12% | 3.71% |
| ARE | 10.07% | 6.04% | 5.52% | 5.72% | 5.67% | 6.05% |

Source: World Bank

Table A4 — Hydrocarbon GDP as a percentage of overall GDP

| | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 |
|---|---|---|---|---|---|---|
| BHR | 29.20% | 24.44% | 18.11% | 12.35% | 20.75% | 27.65% |
| KWT | 83.27% | 54.60% | 46.68% | 50.52% | 64.13% | 68.43% |
| OMN | 64.69% | 52.03% | 52.85% | 40.67% | 55.86% | 67.20% |
| QAT | 85.39% | 59.33% | 57.45% | 44.26% | 65.62% | 76.09% |
| SAU | 84.36% | 36.47% | 54.42% | 41.52% | 55.81% | 75.93% |
| ARE | 80.60% | 51.25% | 62.36% | 38.27% | 45.73% | 50.33% |

Source: World Bank, Energy Administration Information, British Petroleum

[40] Last column is the average year-on-year growth for 1980-2005.

Table A5 — Average of y/o/y overall GDP growth in preceding 5 years[41]

| | 1985 | 1990 | 1995 | 2000 | 2005 | Average |
|---|---|---|---|---|---|---|
| BHR | -1.36% | 2.84% | 7.00% | 4.04% | 5.59% | 3.88% |
| KWT | -6.94% | 5.66% | 10.97% | 1.96% | 7.29% | 2.76% |
| OMN | 15.81% | 6.06% | 4.86% | 3.32% | 4.56% | 6.09% |
| QAT | -5.55% | -2.69% | 0.72% | 7.74% | 18.71% | 3.51% |
| SAU | -2.60% | 1.01% | 4.55% | 1.65% | 3.69% | 1.51% |
| ARE | -0.67% | -1.59% | 5.37% | 5.78% | 6.18% | 2.83% |

Source: World Bank

Table A6 — Average of y/o/y NHGDP growth in preceding 5 years[42]

| | 1985 | 1990 | 1995 | 2000 | 2005 | Average |
|---|---|---|---|---|---|---|
| BHR | 1.54% | 4.28% | 7.92% | 3.84% | 3.64% | 3.96% |
| KWT | 32.78% | 16.08% | 0.88% | 3.51% | 2.44% | 5.30% |
| OMN | 26.42% | 8.87% | 8.93% | 3.15% | -1.01% | 5.79% |
| QAT | 46.60% | 4.83% | 0.66% | 6.52% | 9.77% | 5.49% |
| SAU | 44.22% | 1.29% | 5.17% | 3.17% | -5.98% | 3.21% |
| ARE | 41.32% | -2.37% | 10.39% | 8.55% | 3.36% | 6.62% |

Source: World Bank, Energy Administration Information, British Petroleum

[41] Computed using PPP-adjusted GDP in 2005 Constant International Dollars. Last column is the average year-on-year growth for 1980-2005.
[42] NHGDP is non-hydrocarbon GDP. Last column is the average year-on-year growth for 1980-2005. Last col. is the average year-on-year growth for 1980-2005.

Table A7 — Average of y/o/y per cap. GDP growth in preceding 5 years[43]

| | 1985 | 1990 | 1995 | 2000 | 2005 | Average |
|---|---|---|---|---|---|---|
| BHR | -5.47% | -0.62% | 3.36% | 1.14% | 3.24% | 0.78% |
| KWT | -12.06% | 1.40% | 58.65% | -15.52% | 3.81% | 0.12% |
| OMN | 9.82% | 1.38% | 1.17% | 0.48% | 2.73% | 2.64% |
| QAT | -12.52% | -9.91% | -3.00% | 5.40% | 13.70% | -1.53% |
| SAU | -8.17% | -4.52% | 1.09% | -1.10% | 1.54% | -2.13% |
| ARE | -9.74% | -7.19% | -0.14% | 0.06% | 0.48% | -3.03% |

Source: World Bank

Table A8 — Average of y/o/y per cap. NHGDP growth in preceding 5 years[44]

| | 1985 | 1990 | 1995 | 2000 | 2005 | Average |
|---|---|---|---|---|---|---|
| BHR | -2.69% | 0.77% | 4.25% | 0.94% | 1.33% | 0.87% |
| KWT | 25.26% | 11.43% | 46.96% | -14.54% | -0.99% | 2.60% |
| OMN | 19.88% | 4.06% | 5.11% | 0.32% | -2.74% | 2.35% |
| QAT | 36.56% | -3.08% | -2.98% | 4.21% | 5.12% | 0.36% |
| SAU | 35.99% | -4.26% | 1.79% | 0.38% | -7.89% | -0.49% |
| ARE | 27.78% | -7.93% | 4.63% | 2.68% | -2.18% | 0.54% |

Source: World Bank, Energy Administration Information, British Petroleum

[43] Computed using PPP-adjusted GDP in 2005 Constant International Dollars. Last column is the average year-on-year growth for 1980-2005.
[44] NHGDP is non-hydrocarbon GDP. Computed using PPP-adjusted non-hydrocarbon GDP in 2005 Constant International Dollars. Last column is the average year-on-year growth for 1980-2005.

## 10. Appendix B: Regression Results

Table B1

Dep. Var.: Δln y - QAT excluded from sample

| | PMG | | MG | | Indiv. Hausman | | DFE | |
|---|---|---|---|---|---|---|---|---|
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln r, lagged | -0.171 | 0.292 | -0.026 | 0.131 | | | -0.0474 | 0.7379 |
| Δln p | 41.130 | 38.244 | 12.911 | 10.497 | | | -17.329 | 17.0065 |
| T | 0.098 | 0.096 | 0.042 | 0.046 | | | -0.0058 | 0.0216 |
| Convergence | -0.583*** | 0.189 | -0.597*** | 0.199 | | | -0.0679 | 0.0669 |
| ln $s_+$ | 0.122*** | 0.029 | 1.332 | 1.192 | 1.03 | 0.31 | 0.3057 | 0.7108 |
| ln $g_+$ | -0.265*** | 0.067 | -0.088 | 0.330 | 0.30 | 0.58 | -0.2051 | 0.8518 |
| Joint Hausman | | | | | 7.04 | 0.03 | | |
| ln L | 238.6162 | | 243.0173 | | | | 153.06 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B2

| Dep. Var.: Δln y - QAT excluded from sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln g | -0.236 | 0.248 | -0.088 | 0.330 | | | -0.2051 | 0.8518 |
| ln r, lagged | 0.177 | 0.115 | -0.026 | 0.131 | | | -0.0474 | 0.7379 |
| Δln p | 3.911* | 2.185 | 12.911 | 10.497 | | | -17.3292 | 17.0065 |
| T | 0.001 | 0.01 | 0.042 | 0.046 | | | -0.0058 | 0.0216 |
| Convergence | -0.542** | 0.215 | -0.597*** | 0.199 | | | -0.0679 | 0.0669 |
| ln $s_+$ | 0.125*** | 0.032 | 1.332 | 1.192 | 1.03 | 0.31 | 0.3057 | 0.7108 |
| Joint Hausman | | | | | N/A | N/A | | |
| ln L | 241.9911 | | 243.0173 | | | | 153.06 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B3

| Dep. Var.: Δln y - QAT excluded from sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln s | -2.078 | 2.247 | 1.332 | 1.192 | | | 0.3057 | 0.7108 |
| ln r, lagged | 0.667 | 0.544 | -0.026 | 0.131 | | | -0.0474 | 0.7379 |
| Δln p | -16.436 | 18.919 | 12.911 | 10.497 | | | -17.3292 | 17.0065 |
| T | -0.079 | 0.080 | 0.042 | 0.046 | | | -0.0058 | 0.0216 |
| Convergence | -0.636*** | 0.198 | -0.597*** | 0.199 | | | -0.0679 | 0.0669 |
| ln $g_+$ | -0.282*** | 0.070 | -0.088 | 0.330 | 0.36 | 0.55 | -0.2051 | 0.8518 |
| Joint Hausman | | | | | N/A | N/A | | |
| ln L | 240.9765 | | 243.0173 | | | | 153.06 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B4

Dep. Var.: Δln y - regressor ΔΔln p not included

| | PMG | | MG | | Indiv. Hausman | | DFE | |
|---|---|---|---|---|---|---|---|---|
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln r, lagged | 0.28 | 0.217 | 0.254** | 0.128 | | | 2.4659 | 3.8569 |
| Δln p | 4.542* | 2.695 | 3.195** | 1.614 | | | 35.2733 | 70.8296 |
| T | 0.021* | 0.012 | -0.002 | 0.008 | | | 0.0389 | 0.0863 |
| Convergence | -0.606*** | 0.176 | 0.188 | 0.679 | | | 0.0296 | 0.0597 |
| $\ln s_+$ | 0.124*** | 0.024 | -0.019 | 0.066 | 5.47 | 0.02 | -1.9186 | 3.8221 |
| $\ln g_+$ | -0.236*** | 0.052 | -0.257 | 0.221 | 0.01 | 0.92 | 2.2549 | 4.1337 |
| Joint Hausman | | | | | 7.12 | 0.03 | | |
| ln L | 264.1958 | | 276.8233 | | | | 160.45 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B5

| Dep. Var.: Δln y - regressor ΔΔln p not included | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln g | -0.271 | 0.204 | -0.257 | 0.221 | | | 2.2549 | 4.1337 |
| ln r, lagged | 0.162 | 0.145 | 0.254** | 0.128 | | | 2.4659 | 3.8569 |
| Δln p | 2.592 | 1.596 | 3.195** | 1.614 | | | 35.2733 | 70.8296 |
| T | 0.01 | 0.013 | -0.002 | 0.008 | | | 0.0389 | 0.0863 |
| Convergence | -0.562*** | 0.204 | 0.188 | 0.679 | | | 0.0296 | 0.0597 |
| ln $s_+$ | 0.121 | 0.024 | -0.019 | 0.066 | 5.27 | 0.02 | -1.9186 | 3.8221 |
| Joint Hausman | | | | | N/A | N/A | | |
| ln L | 267.0999 | | 276.8233 | | | | 160.45 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B6

| Dep. Var.: Δln y - regressor ΔΔln p not included | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG Estimates | | MG Estimates | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln s | -0.024 | 0.086 | -0.019 | 0.066 | | | -1.9186 | 3.8221 |
| ln r, lagged | 0.398** | 0.183 | 0.254** | 0.128 | | | 2.4659 | 3.8569 |
| Δln p | 4.83** | 2.407 | 3.195** | 1.614 | | | 35.2733 | 70.8296 |
| T | 0.008 | 0.009 | -0.002 | 0.008 | | | 0.0389 | 0.0863 |
| Convergence | -0.048 | 0.495 | 0.188 | 0.679 | | | 0.0296 | 0.0597 |
| ln $g_+$ | -0.182*** | 0.053 | -0.257 | 0.221 | 0.12 | 0.72 | 2.2549 | 4.1337 |
| Joint Hausman | | | | | N/A | N/A | | |
| ln L | 269.5850 | | 276.8233 | | | | 160.45 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B7

| Dep. Var.: $\Delta$ln y' - QAT excluded from sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln r, lagged | 0.684** | 0.28 | 0.966** | 0.416 | | | 0.4084* | 0.2219 |
| $\Delta$ln p | -5.312 | 6.632 | -0.008 | 4.496 | | | -7.5987*** | 2.0259 |
| T | -0.046* | 0.025 | -0.026** | 0.012 | | | -0.0258** | 0.0110 |
| Convergence | -0.462*** | 0.113 | -0.558*** | 0.159 | | | -0.1639*** | 0.0442 |
| ln $s'_+$ | -0.16* | 0.084 | -0.889 | 0.617 | 1.42 | 0.23 | -0.303 | 0.2422 |
| ln $g'_+$ | -1.023*** | 0.135 | -0.684 | 0.515 | 0.47 | 0.50 | -0.3671 | 0.3516 |
| Joint Hausman | | | | | 1.42 | 0.49 | | |
| ln L | 181.3067 | | 196.8852 | | | | 128.87 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B8

| Dep. Var.: Δln y' - regressor ΔΔln p not included | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG Estimates | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln r, lagged | -0.419 | 0.341 | 1.059* | 0.551 | | | 0.2549 | 0.3142 |
| Δln p | -29.006 | 20.711 | 1.288 | 5.872 | | | -10.038*** | 3.8160 |
| t | -0.137 | 0.139 | -0.094 | 0.059 | | | -0.0397** | 0.0190 |
| Convergence | -0.379*** | 0.098 | -0.421** | 0.166 | | | -0.1073*** | 0.0395 |
| $\ln s'_{+}$ | 0.255** | 0.124 | -0.744* | 0.391 | 7.26 | 0.01 | 0.0000 | 0.3818 |
| $\ln g'_{+}$ | -0.809*** | 0.075 | -0.52 | 0.575 | 0.26 | 0.61 | -0.6125 | 0.5145 |
| Joint Hausman | | | | | 7.96 | 0.02 | | |
| ln L | 201.8570 | | 231.2986 | | | | 140.17 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B9

| Dep. Var.: Δln y' - QAT excluded from sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln r, lagged | 0.65** | 0.255 | 0.781* | 0.298 | | | 0.4975** | 0.2130 |
| Δln p | -0.597 | 7.221 | -0.048 | 5.582 | | | -7.288*** | 1.8120 |
| t | -0.039* | 0.024 | -0.032** | 0.016 | | | -0.0285*** | 0.0107 |
| Convergence | -0.551*** | 0.136 | -0.664*** | 0.133 | | | -0.1756*** | 0.0445 |
| ln $s'_{+}$ | -0.149* | 0.079 | -0.499* | 0.286 | 1.62 | 0.20 | -0.3849* | 0.2244 |
| ln $g'_{+}$ | -0.994*** | 0.114 | -0.742 | 0.559 | 0.21 | 0.65 | -0.4099 | 0.3305 |
| $inf_{+}$ | -1.708*** | 0.562 | -5.06 | 3.195 | 1.14 | 0.29 | -4.1106* | 2.4022 |
| Joint Hausman | | | | | 2.34 | 0.50 | | |
| ln L | 186.2325 | | 207.8327 | | | | 130.84 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B10

| Dep. Var.: Δln y' - QAT excluded from sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln ex' | -0.459 | 0.448 | 0.089 | 0.631 | | | 0.038 | 0.7995 |
| ln im' | 0.213 | 0.226 | -0.089 | 0.352 | | | 0.6426 | 0.4574 |
| ln r, lagged | 0.182 | 0.439 | -0.174 | 0.6 | | | 0.2075 | 0.5182 |
| Δln p | -6.29* | 3.155 | -8.662 | 6.727 | | | -12.0278 | 8.7753 |
| t | -0.023 | 0.016 | -0.049 | 0.032 | | | -0.0158 | 0.0213 |
| Convergence | -0.604 | 0.173 | -0.763 | 0.174 | | | -0.1044 | 0.0727 |
| ln $s'_+$ | -0.104* | 0.052 | -0.234 | 0.155 | 0.78 | 0.38 | -0.5287 | 0.4938 |
| ln $g'_+$ | -0.442*** | 0.056 | -0.117 | 0.282 | 1.38 | 0.24 | -0.0913 | 0.4978 |
| $inf_+$ | -1.019*** | 0.167 | -4.281** | 2.121 | 2.38 | 0.12 | -8.3424 | 6.8876 |
| Joint Hausman | | | | | .. | .. | | |
| ln L | 270.4217 | | 298.8099 | | | | 146.41 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B11

| Dep. Var.: Δln y' - QAT excluded from sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln cr2' | -0.052 | 0.327 | 0.47 | 0.881 | | | -0.521*** | 0.1346 |
| ln r, lagged | 0.557*** | 0.158 | 0.955* | 0.58 | | | 0.4925*** | 0.1385 |
| Δln p | 6.549 | 8.019 | -18.221* | 10.332 | | | -5.027*** | 0.9574 |
| t | -0.015** | 0.007 | -0.076 | 0.048 | | | -0.0124 | 0.0066 |
| Convergence | -0.556*** | 0.188 | -0.74*** | 0.185 | | | -0.2578 | 0.0432 |
| ln $s'_{+}$ | -0.398*** | 0.135 | -1.196 | 1.097 | 0.54 | 0.46 | -0.2819* | 0.1531 |
| ln $g'_{+}$ | -0.195 | 0.123 | 0.498 | 1.688 | 0.17 | 0.68 | -0.601*** | 0.2336 |
| $inf_{+}$ | -1.601*** | 0.552 | -11.045 | 10.89 | 0.75 | 0.39 | -3.9799** | 1.6298 |
| Joint Hausman | | | | | .. | .. | | |
| ln L | 196.2151 | | 224.5722 | | | | 136.21 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.

Table B12

| Dep. Var.: Δln y' - QAT excluded from sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | PMG | | MG | | Indiv. Hausman | | DFE | |
| | Est. | Std. Err. | Est. | Std. Err. | Test Stat. | p-value | Est. | Std. Err. |
| ln cr1' | 0.777 | 0.615 | -0.186 | 0.408 | | | -0.0066 | 0.0430 |
| ln r, lagged | 0.596*** | 0.175 | 1.001*** | 0.385 | | | 0.5115** | 0.2197 |
| Δln p | -0.096 | 4.71 | -4.165 | 6.269 | | | -7.308*** | 1.8193 |
| t | -0.051** | 0.021 | -0.038*** | 0.008 | | | -0.0271** | 0.0113 |
| Convergence | -0.545*** | 0.137 | -0.567*** | 0.123 | | | -0.176*** | 0.046 |
| $\ln s'_{+}$ | -0.166** | 0.072 | -0.834* | 0.485 | 1.94 | 0.16 | -0.3813* | 0.2258 |
| $\ln g'_{+}$ | -1.133*** | 0.163 | -0.507 | 0.56 | 1.37 | 0.24 | -0.4154 | 0.3427 |
| $inf_{+}$ | -1.71*** | 0.542 | -4.873 | 3.468 | 0.85 | 0.36 | -4.0995* | 2.5805 |
| Joint Hausman | | | | | 2.41 | 0.49 | | |
| ln L | 195.0354 | | 220.6304 | | | | 129.58 | |

Notes: *,**,*** indicate significance at the 10%, 5%, and 1% levels respectively.

+ subscript denotes variable restricted to be the same across countries in the long run.