ECONOMETRIE DE DONNEES DE PANEL

Cours Méthodologique EDOCIF

Examen Final

Juin 2003

Les documents de cours et les calculatrices sont autorisés

1 Exercice (10 points)

On considère une fonction de production de type Cobb Douglas à deux facteurs exprimée. On désigne respectivement par $n_{i,t}$ et $k_{i,t}$, le niveau d'emploi et de capital en logarithme du pays i à la date t. Le logarithme de la production est représentée par le modèle suivant. $\forall\, i = 1, .., N$, $\forall\, t = 1, .., T$

$$y_{i,t} = \alpha_i + e_k k_{i,t} + e_n n_{i,t} + v_{i,t} \tag{1}$$

où e_k et e_n désignent les élasticités de la production par rapport à l'emploi et au capital et où les termes $v_{i,t}$ sont supposés être $i.i.d.$ $\left(0, \sigma_v^2\right)$.

1.1 Questions préliminaires (1.5 point)

Question 1 *(1 point)* **:** *Expliquez précisément quelles sont les implications économiques de cette spécification et plus particulièrement ce que représentent les effets individuels dans ce modèle.*

Question 2 *(0.5 point)* **:** *Discutez brièvement suivant la spécification (fixe ou aléatoire) des effets individuels, les propriétés respectives des estimateurs des MCO et des MCG.*

1.2 Modèle à Effets Individuels Aléatoires (4 points)

On suppose que les **effets individuels** α_i **sont aléatoires** et vérifient les hypothèses suivantes :

$$E\left(\alpha_i\right) = \alpha \qquad E\left[\left(\alpha_i - \alpha\right) v_{i,t}\right] = 0$$

$$E\left[\left(\alpha_i - \alpha\right)\left(\alpha_j - \alpha\right)\right] = \begin{cases} \sigma_\alpha^2 & i = j \\ 0 & \forall i \neq j \end{cases}$$

On définit $\varepsilon_{i,t} = \alpha_i + v_{i,t}$ les résidus globaux du modèle.

Question 3 *(2 points)* **:** *Calculez $E\left(\varepsilon_{i,t}\right)$ et donnez l'expression de la covariance $cov\left(\varepsilon_{i,t}, \varepsilon_{is}\right)$ suivant la valeur des indices t et s. On rappelle que $cov\left(x, y\right) = E\left[\left(x - E\left(x\right)\right)\left(y - E\left(y\right)\right)\right]$. Commentez.*

Question 4 *(1 point)* **:** *Donnez l'expression de la covariance $cov\left(\varepsilon_{i,t}, \varepsilon_{js}\right)$ en fonction des indices individuels i, j et des indices temporels t, s. Commentez.*

Question 5 *(1 point)* **:** *Compte tenu des résultats précédents, indiquez quelle est la conséquence sur la matrice de variance des résidus globaux du modèle (1) de l'introduction d'effets individuels aléatoires.*

1.3 Spécification Mundlak et biais d'estimation (4.5 points)

On suppose à présent que les effets individuels sont corrélés avec le niveau de capital, mais sont non corrélés avec le niveau d'emploi $\forall i = 1, .., N$, $\forall t = 1, .., T$:

$$E(\alpha_i k_{i,t}) \neq 0 \qquad E(\alpha_i n_{i,t}) = 0 \tag{2}$$

Question 6 *(0.5 point)* **:** *Donnez une interprétation économique précise à ces deux hypothèses.*

On retiendra par la suite la spécification de Mundlak (1978) pour les effets individuels :

$$\alpha_i = a\overline{k}_i + \alpha_i^* \tag{3}$$

où $\overline{k}_i = (1/T)\sum_{t=1}^{T}$ désigne le niveau moyen de capital pour le pays i et où α_i^* correspond à la composante $i.i.d.\,(0, \sigma_\alpha^*)$ des effets individuels.

Question 7 *(2 points)* **:** *En utilisant les résultats de cours, montrez que sous ces hypothèses l'estimateur Between $\widehat{e}_n^B$ de l'élasticité du travail e_n est convergent, que celui de l'élasticité du capital e_k est biaisé.*

$$\underset{N\to\infty}{plim}\ \widehat{e}_n^B = e_n \qquad \underset{N\to\infty}{plim}\ \widehat{e}_k^B = e_k + a \tag{4}$$

tandis que les estimateurs Within, notés respectivement $\widehat{e}_n^W$ et $\widehat{e}_k^W$, de ces paramètres sont convergents

$$\underset{TN\to\infty}{plim}\ \widehat{e}_n^W = e_n \qquad \underset{TN\to\infty}{plim}\ \widehat{e}_k^W = e_k \tag{5}$$

Question 8 *(2 points): En utilisant les résultats de cours et les résultats de la question 7, montrez à T fixé que l'estimateur des MCG, noté $\widehat{e}_k^M$, de l'élasticité du capital est biaisé et que le biais semi-asymptotique est défini par :*

$$\underset{N\to\infty}{plim}\ \widehat{e}_k^M = e_k + \Delta_{kk}a \tag{6}$$

où Δ_{kk} est l'élément de la matrice Δ telle que $\widehat{\beta}^M = \Delta\widehat{\beta}^B + (I_K - \Delta)\widehat{\beta}^W$, $\beta = (e_n\ e_k)'$ avec

$$\underset{(2,2)}{\Delta} = \begin{pmatrix} \underset{(1,1)}{\Delta_{nn}} & \underset{(1,1)}{\Delta_{nk}} \\ \underset{(1,1)}{\Delta_{kn}} & \underset{(1,1)}{\Delta_{kk}} \end{pmatrix} \tag{7}$$

Rappelez la forme général de la matrice Δ. Que devient ce biais lorsque T tend vers l'infini ?

2 Problème (7 points)

Commentez l'article d'Annie Corbin (2001) concernant le paradoxe de Feldstein - Horioka et la nécessaire présence d'effets individuels spécifiques aux pays étudiés.

Question 1 : Décrivez la problématique économique, l'approche économétrique de l'auteur et ses résultats.

Question 2 : Commentez l'approche méthodologique retenue, ses avantages et ses limites au regard de la problématique économique traitée.

3 Exercice (4 points)

On s'intéresse au lien entre développement financier et croissance économique à partir d'un panel de 16 pays africains. Les données annuelles (1967-1998) proviennent de la base "*World Development Indicators*" (CD-rom édition, 2000). On note $CRED$ le ratio de l'encours de crédit bancaire au secteur privé rapporté au PIB, et l'on note PIB le niveau du PIB réel par tête.

Question : *Commentez rapidement le programme suivant :*

```
load(file = "Afrique.wks");
lpib=log(pib);
lqsm=log(qsm);
?-- Taux de Croissance ---
select i=i(-1);
dpib=lpib-lpib(-1);
dqsm=lqsm-lqsm(-1);
?--- Estimation ----
select i=i(-2);
panel (id=i,time=t,byid) dpib dqsm dqsm(-1);
```

Question 2 : *Analysez les résultats du fichier de résultats TSP joint et dégagez le modèle adéquat qui doit être estimé dans ce cas ainsi que les résultats obtenus.*

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Country specific effect in the Feldstein–Horioka paradox: a panel data analysis

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Abstract

Using panel data methods, this study leads to a new interpretation of the Feldstein–Horioka paradox. A high estimated saving–investment coefficient may be due less to low capital mobility than to the existence of specific individual country effects.

Keywords: Feldstein–Horioka; Panel data; Capital mobility

JEL classification: C1; F3

1. Introduction

Obtaining a correlation of saving and investment close to one in their cross-section analysis for sixteen industrialised OECD countries for the 1960–1974 period, led Feldstein and Horioka (1980) to reject the perfect capital mobility assumption. A number of subsequent analyses using cross-section or times series data have confirmed Feldstein and Horioka's results and have attempted to reconcile them with the capital mobility hypothesis.

In fact the existence of a high correlation coefficient between saving and investment could be compatible with the hypothesis of capital mobility in the long term. The persistent correlation between saving and investment may be not due so much to imperfect capital mobility than to the procyclical character of saving and investment in a real business cycle model. This has led to a number of authors undertaking cross-section analysis on sample averages in the period thus eliminating the influence of these cycles in the saving–investment correlation. In addition, the inclusion of a solvency constraint (no Ponzi financing) in this analysis has led to a new interpretation of the high saving–investment correlation being suggested. In the long term, the intertemporal budget constraint is an indicator of a

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country's solvency. This is expressed in terms of current account constancy which can be interpreted in the Feldstein–Horioka approach as evidence of imperfect capital mobility (Coakley et al., 1996).

Furthermore, Murphy (1984) and Baxter and Crucini (1993) suggest that a high domestic saving–investment correlation reflects the country's financial size in the world economy. When the country's financial system is highly developed in international terms, exogenous variations in domestic saving and investment rates affect world interest rates and induce joint movements in domestic saving and investment rates. The Feldstein and Horioka test can then be interpreted as a joint test of the hypothesis of capital mobility and the size of a country's financial system. If the capacity of a country to influence interest rates on world capital markets is an important explanatory factor of the finding of a high correlation coefficient for saving and investment, the estimation of a regression in which the sample countries are treated as identical in terms of their capacity to influence conditions on international capital markets could bias the correlation coefficient upwards or downwards.

Using panel data methods, the present study examines whether individual country specific effects exist in a context of international financial integration. The coexistence of the two dimensions, individual (country by country) and temporal (year by year) in the data allows us to estimate the coefficient of correlation of saving and investment for ten OECD countries in the 1885–1992 period using four estimation procedures, pooled, between, within and a variant of the errors components model (random effects [RE] model).

The estimators are differentiated by the importance that they give to individual and temporal dimensions. The pooled estimator assumes both individual homogeneity and the temporal stability of the relation. The between estimator is obtained from the average ratios from each country in the period. It emphasises the inter-country dimension and rules out the temporal variability. Like the pooled estimator, it postulates individual homogeneity for the countries. The within estimator is calculated from the difference between the saving and investment ratio and the individual country time averages. It uses the intra-country variability and takes into account for the heterogeneity of the data.

The empirical study of financial integration generally uses the between estimator in cross-section analysis without justification. The current study systematically calculates the four estimators. The differences between them are very informative concerning the structure of the variance of the data. The decomposition of the total variance of the observations between the between and within variances allows us to evaluate the relative importance of the individual and temporal dimensions of the data. So, with compared to the pooled estimator, the within estimator in adding individual effects provides information concerning potential inter-individual heterogeneity. In the same way, the existence of an atypical country with a saving–investment ratio very different from the rest of the sample can distort the between estimator. The within estimator is helpful in this context because it takes account of differences with regard to the average. Using these panel data methods, we find that there are indeed individual country specific effects in the financial integration framework. The issue of whether the individual specific effects are correlated with the explanatory variables is examined using a Hausman test (Hausman, 1978).

2. Results

Over this period of more than 100 years there have been a number of international monetary regimes. These have implications for the free circulation of capital. The sample period as a consequence has been divided into four sub-periods, 1885–1913, 1921–1944, 1946–1972, 1973–1992[1] and each sub-period corresponds to a particular regime. The gold standard regime characteristic of the end of the late 19th century (1880–1913) was restored in 1925. From the point of view of the circulation of capital, the functioning takes place in very different contexts. After a period of high capital mobility pre-1914 there was a significant decline in the inter-war period. This regime, as well the financial supremacy of London, reached its apogee in 1931. With the Bretton–Woods agreements established after the Second World War, the United States became the main financial centre of the world. After a period of monetary instability and the introduction of capital controls, the regime of fixed but adjustable exchange rates came to an end in 1973 and gave way to a generalised floating exchange rate regime which led in turn to a broad movement towards the liberalisation of capital movements. In order to obtain a balanced sample with regard to the number of observations, the different sub-periods adopted are those for which the number of observations is the greatest.

Table 1 presents the values of the different estimators, pooled, between, within and RE calculated over the different sub-periods. The values of the pooled, within and RE estimators are similar whatever the sub-period considered. The between estimator is always significantly higher.

Over the sub-period (1880–1913), the pooled, within and RE estimates are around 0.40 and suggest a relatively high degree of financial integration even if they are significantly different from zero. The difference between the value of the between and within estimators confirms this result. Indeed the finding of a relatively high coefficient of saving–investment correlation for the between estimator (0.65) may indicate not so much a low degree of financial integration than the presence of atypical countries in the sample which upwardly bias the value of this estimator. The relatively high value of the between estimator is similar to the value obtained over the same sub-period (0.63) by Eichengreen (1992) in a sample of countries including the United States.

There exist several ways of taking into account country heterogeneity. The within procedure eliminates the bias due to the existence of specific countries effects which are assumed to be fixed and correlated with the explanatory variable. The RE model incorporates country heterogeneity by including a specific unobservable country effect in the error term. The latter is assumed to be uncorrelated with the explanatory variable.

Table 1
Estimation of the correlation coefficient for saving and investment[a]

	1885–1913[b]	1921–1944	1946–1972	1973–1992
Pooled	0.43 (0.05)	0.58 (0.046)	0.50 (0.041)	0.80 (0.03)
Between	0.65 (0.10)	0.74 (0.25)	0.87 (0.24)	1.06 (0.15)
Within	0.40 (0.05)	0.56 (0.04)	0.47 (0.41)	0.74 (0.03)
Random effects	0.42 (0.05)	0.57 (0.04)	0.48 (0.41)	0.76 (0.03)
Test on individual effects	$F_{11,335} = 0.747$	$F_{8,206} = 2.18$	$F_{9,259} = 2.96$	$F_{9,459} = 5.29$
[P value]	[0.69]	[0.03]	[0.002]	[0.000]
Hausman test	$\chi^2(1) = 1.19$	$\chi^2(1) = 0.74$	$\chi^2(1) = 3.6$	$\chi^2(1) = 9.5$
[P value]	[0.27]	[0.39]	[0.05]	[0.00]

[a] Standard error appears in parentheses.
[b] F-statistic for the test on the existence of an individual effect is $F_{10,307} = 1.67$ with [0.08] when the United States is not included in the sample.

[1] See Appendix A.

Statistically speaking, the elimination of these specific individual effects in the within model induces a substantial loss of degrees of freedom (Greene, 1997). By introducing the individual specific effect in the error term, the RE estimator avoids this criticism. Thus, it is generally acknowledged that when the specific effects are not correlated with the explanatory variables the RE estimator is consistent and efficient, the within estimator being consistent but not efficient.[2] This requires that the existence of such an effect should first be tested.[3] The null hypothesis of the absence of a fixed individual effect is accepted in the sub-period 1885–1913 for the twelve countries but rejected significantly at 10% when the United States is excluded from the sample (Table 1). The hypothesis of the independence of the error term with regard to the saving rate in the sub-period 1885–1913 in the RE model is accepted by a Hausman test (Hausman, 1978). This justifies this approach to heterogeneity in the sub-period.

The interwar period (1921–1944) is characterized by an increase of the values of the four estimators. The between estimator (0.74) is significantly higher than in the preceding period as are the values of the pooled, within and RE estimates (around 0.57). But the similarity of the pooled and within estimates mitigates the decline in financial integration implied by the higher value of the between estimator and reflects the importance of the within variance in the total variance (Table 2).

In the postwar period (1946–1972), the between coefficient (0.87) is significantly higher than in the preceding period. The pooled (0.50), within (0.47) and RE (0.48) estimators show that when the heterogeneity of the countries is specified in the model lower values are obtained. These three estimators provide lower values compared to the previous sub-period and suggest a relative increase in capital mobility in this sub-period. The increase in the between coefficient over the two sub-periods is accompanied by an increase in the share of the between dimension in the total variance. The between estimates overestimate the decline in the capital mobility in this sub-period. The within estimate gives in return values much lower and closer to the observed values in the Gold Standard sub-period which was a period of high capital mobility. The hypothesis of the existence of a fixed specific effect is accepted in the sub-period (Table 1). The Hausman test (Hausman, 1978) points to the exogeneity of the individual effects.

During the sub-period 1973–1992, the estimated values of the four estimators increase significantly. The pooled estimator (0.80) seems to reflect a less settled combination of individual and temporal effects. Indeed the between variance increases slightly in this sub-period (Table 2). The hypothesis of the existence of a fixed individual effect is accepted (Table 1). The Hausman test (Hausman, 1978) suggests that some of the individual effects are correlated with the explanatory variable during this sub-period. This result underlines the importance of the unobservable individual effects which are correlated with the explanatory variable as an explanation for the overestimate of the decline of the

Table 2
Structure of the variance[a]

	1880–1913	1921–1944	1946–1972	1973–1992
V_{with}/V_{tot} (%)	98.1	95.7	93.8	83.6

[a] V_{with} = within variance; V_{tot} = total variance.

[2] See Davidson and MacKinnon, 1993; Johnston and Dinardo, 1997.

[3] See Baltagi, 1995; Hsiao, 1986.

financial integration during this sub-period suggested by the high value of the between estimator. This result shows that it is essential to take into account the persistent unobservable differences that exist between the countries in the estimation of the saving–investment correlation.

3. Conclusion

This study has underlined the importance of controlling for the heterogeneity of countries in a cross-section analysis of the saving–investment correlation for a group of countries using panel data. The individual and temporal dimensions of the data enables the estimation of the coefficient of the saving–investment correlation for a group of ten OECD countries during the period 1885–1992 according to three procedures (pooled, between, within) as well as a variant of the error components model (RE).

The existence of transitory unobservable differences between the countries is characterised more in the process of financial integration during the first three sub-periods. During the last sub-period, the existence of individual unobservable attributes which are not taken into account in the estimation of the saving–investment correlation but correlated with the explanatory variable give rise to high estimated coefficients.

This conclusion suggests a new interpretation of Feldstein and Horioka's results. Obtaining a high coefficient of correlation in the cross-section analysis, may be less due to the existence of a common characteristic affecting all the countries in the sample in the same way in a given period (imperfect capital mobility) than to the existence of specific individual country effects.

Appendix A

This data base is borrowed from Taylor (1996). The studied countries are Argentina (ARG), Australia (AUS), Canada (CAN), Denmark (DNK), France (FRA), Germany (GER), Italy (ITA), Japan (JPN), Norway (NOR), Sweden (SWE), Great Britain (GBR), and United States (US). The abbreviation for each country is indicated in brackets. As in Taylor (1996), in the period 1850–1914, the investment rates $(I/Y)_t$ are defined with the ratio of gross domestic investment I_t to national income Y_t at current prices, the saving rate $(S/Y)_t$ is deducted from the identity $(S/Y)_t = (I/Y)_t + (CA/Y)_t$, where CA designs the current account. The same procedure is used in order to calculate $(I/Y)_t$ and $(S/Y)_t$ over the period 1915–1959. Over the period 1960–1992, $(I/Y)_t$ and $(S/Y)_t$ represents the share of gross domestic investment and the share of gross domestic saving to gross domestic product at current prices. For more details concerning the data base, see Taylor (1996), p.28, data appendix.

In fact the observation periods for each country are 1885–1992 (ARG), 1861–1992 (AUS), 1870–1992 (CAN), 1874–1914, 1921–1992 (DNK), 1850–1913, 1922–1938, 1949–1992 (FRA), 1860–1913, 1925–1935, 1950–1992 (GER), 1861–1992 (ITA), 1885–1944, 1946–1992 (JAP), 1865–1939, 1946–1992 (NOR), 1861–1992 (SWE), 1850–1992 (GBR), 1874–1992 (US).

The countries excluded for each sub-period are: in the sub-period (1921–1944), Germany, France and Norway; in the sub-periods (1946–1972) and (1973–1992) Germany, France.

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                                    USA
          PROGRAM
 LINE
*******************************************************************
 |      1  load (file="Afrique.wks");
 |      2  lpib=log(pib);
 |      3  lqsm=log(qsm);
 |      4
 |      4  ?-- Taux de Croissance ---
 |      4  select i=i(-1);
 |      5  dpib=lpib-lpib(-1);
 |      6  dqsm=lqsm-lqsm(-1);
 |      7
 |      7  ?--- Estimation ----
 |      7  select i=i(-2);
 |      8  panel (id=i,time=t,byid) dpib dqsm dqsm(-1);
 |      9
          EXECUTION

**********************************************************************
**********

 Current sample:  1 to 512

 Current sample:  3 to 32, 35 to 64, ..., 483 to 512  (480 obs.)

                      PANEL DATA ESTIMATION
                      =====================

 Balanced data:  NI=   16, T=   30, NOB=   480
 WARNING:  lags require a SMPL with gaps like
  SELECT @ID=@ID(-1);

 TOTAL (plain OLS) Estimates:

 Dependent variable: DPIB

  Mean of dependent variable = .228819E-02
 Std. dev. of dependent var. = .062469
    Sum of squared residuals = 1.85482
       Variance of residuals = .388852E-02
    Std. error of regression = .062358
                   R-squared = .771687E-02
          Adjusted R-squared = .355635E-02

            Estimated    Standard
 Variable  Coefficient     Error       t-statistic
 DQSM      .023311       .014030       1.66151
 DQSM(-1)  .015617       .012610       1.23849
 C         .782611E-03   .295663E-02   .264696

 F test of A,B=Ai,Bi:  F(45,432) = 0.76413,  P-value = [.8663]
```

Critical F value for diffuse prior (Leamer, p.114) = 7.5253

BETWEEN (OLS on means) Estimates:

Dependent variable: DPIB

Mean of dependent variable = .228819E-02 Std. error of regression = .010622
Std. dev. of dependent var. = .994413E-02 R-squared = .011132
Sum of squared residuals = .146677E-02 Adjusted R-squared = -.141001
Variance of residuals = .112829E-03

Variable	Estimated Coefficient	Standard Error	t-statistic
DQSM	.074959	.223397	.335541
DQSM(-1)	-.033756	.157520	-.214294
C	.111903E-02	.448073E-02	.249743

WITHIN (fixed effects) Estimates:

Dependent variable: DPIB

Sum of squared residuals = 1.81045 R-squared = .031458
Variance of residuals = .391871E-02 Adjusted R-squared = -.418065E-02
Std. error of regression = .062600

Variable	Estimated Coefficient	Standard Error	t-statistic
DQSM	.023588	.014256	1.65460
DQSM(-1)	.016117	.012878	1.25145

F test of Ai,B=Ai,Bi: F(30,432) = 0.77423, P-value = [.8006]
Critical F value for diffuse prior (Leamer, p.114) = 6.7807

F test of A,B=Ai,B: F(15,462) = 0.75499, P-value = [.7278]
Critical F value for diffuse prior (Leamer, p.114) = 6.5542

Variance Components (random effects) Estimates:

VWITH (variance of Uit) = 0.39187E-02
VBET (variance of Ai) = -0.30193E-04
(computed from small sample formula)

Variance Components (random effects) Estimates:

VWITH (variance of Uit) = 0.37718E-02
VBET (variance of Ai) = 0.92456E-04
(computed from large sample formula)
THETA (0=WITHIN, 1=TOTAL) = 0.57624

Dependent variable: DPIB

Sum of squared residuals = 1.83602 R-squared = .017777
Variance of residuals = .397407E-02 Adjusted R-squared = -.018366
Std. error of regression = .063040

Variable	Estimated Coefficient	Standard Error	t-statistic

```
 DQSM       .023424       .013887       1.68669
 DQSM(-1)   .015824       .012508       1.26506
 C          .769604E-03   .377761E-02   .203728

 Hausman test of H0:RE vs. FE:  CHISQ(2) = 0.92743E-02,  P-value =
[.9954]


**********************************************************************
**********

 END OF OUTPUT.

 TOTAL NUMBER OF WARNING MESSAGES:   2

   MEMORY USAGE:    ITEM:    DATA ARRAY  TOTAL MEMORY
                   UNITS:  (4-BYTE WORDS) (MEGABYTES)
   MEMORY ALLOCATED        :    500000       4.0
   MEMORY ACTUALLY REQUIRED :     13170       2.2
   CURRENT VARIABLE STORAGE :      8160
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