NOTES D'ÉTUDES

ET DE RECHERCHE

GLOBAL AGEING AND MACROECONOMIC

CONSEQUENCES OF DEMOGRAPHIC UNCERTAINTY

IN A MULTI-REGIONAL MODEL

Juha Alho and Vladimir Borgy

BANQUE DE FRANCE

EUROSYSTÈME

DIRECTION GÉNÉRALE DES ÉTUDES ET DES RELATIONS INTERNATIONALES

GLOBAL AGEING AND MACROECONOMIC

CONSEQUENCES OF DEMOGRAPHIC UNCERTAINTY

IN A MULTI-REGIONAL MODEL

Juha Alho and Vladimir Borgy

July 2007

NER - E # 174

Global Ageing and Macroeconomic Consequences of Demographic Uncertainty in a Multi-regional Model[1]

Juha Alho[2] and Vladimir Borgy[3]

[2] University of Joensuu, Finland. E-mail: juha.alho@joensuu.fi

[3] Banque de France & CEPII. E-mail: vladimir.borgy@banque-france.fr. Address: Banque de France. DGEI-DIR-RECFIN- 41-1391 - 31 rue croix des petits champs - 75049 Paris cedex 01. Tel.: +33 1 42 92 48 89.

Résumé

Dans cette étude, nous analysons les conséquences de l'incertitude démographique dans un modèle d'équilibre général mondial à générations imbriquées (INGENUE 2). Nous considérons le niveau d'incertitude dans les dix régions du monde ainsi que le degré de corrélation des erreurs de prévision démographique entre les régions du modèle. Nous réalisons des simulations stochastiques de population, puis nous les introduisons dans le modèle économique. Ces simulations nous permettent d'analyser l'incertitude affectant les principales variables macroéconomiques (taux de croissance du PIB, taux d'intérêt mondial…) engendrée par la prise en compte de l'incertitude démographique. Nous montrons également que les hypothèses relatives au degré de corrélation des erreurs de prévision entre les régions sont cruciales : elles conditionnent l'ampleur de l'incertitude économique et elles affectent les ajustements macroéconomiques à l'œuvre dans le modèle. En particulier, les comportements d'épargne des agents dans les différentes régions et leurs conséquences sur la configuration mondiale des soldes courants diffèrent substantiellement selon les hypothèses faites sur le degré de corrélation interrégionale des erreurs de prévision démographique.

Classification J.E.L. **:** C68, F21, D91, J11.

Mots clés **:** Modèles d'équilibre général calculable, mouvements internationaux de capitaux, modèle de cycle de vie et épargne, projections démographiques.

Abstract

In this paper, we investigate the impact of demographic uncertainty in a multi-regional general equilibrium, overlapping generations model (INGENUE 2). Specifically, we will consider the level of uncertainty in each of the ten major regions of the world, and their correlation across regions. In order to address these issues, we produce stochastic simulations of the world population for the ten regions until 2050. Then, we will analyse the economic consequences on a path by path basis over the period 2000-2050. These simulations allow us to assess the uncertainty induced into key macro-economic variables, the GDP growth rate and the world interest rate in particular, by uncertain future demographics. We show that the assumptions regarding interregional correlations of forecast errors are important in our model: they have a large impact on the uncertainty of the macroeconomic variables, and it appears that the macroeconomic adjustments can differ substantially if we consider independence or high correlation across the regions. In particular, the macroeconomic behaviour of the agents in the current account/saving problem differs significantly across regions according to the degree of interregional correlation.

J.E.L. Classification **:** C68, F21, D91, J11.

Keywords **:** Computable General Equilibrium Models, International capital flows, Life cycle models and saving, Demographic trends and forecasts.

Résumé non technique

Alors que la démographie a de longue date été identifiée comme une variable clé des évolutions macroéconomiques de long terme, la plupart des travaux menés jusqu'à présent se basent principalement sur des projections de population déterministes. Pourtant, comme l'attestent un certain nombre de travaux récents, les évolutions démographiques futures sont incertaines et la prise en compte de cette incertitude par des scénarios en variante présente un certain nombre de limites. En particulier, les projections déterministes de population ne permettent pas d'assigner des probabilités aux différentes trajectoires de population envisagées.

Les conséquences macroéconomiques de l'incertitude démographique n'ont pas, jusqu'à présent, été analysées dans le cadre d'un modèle économique multi-régions. L'analyse de ces conséquences dans le cadre d'un tel modèle s'avère pourtant pertinente pour plusieurs raisons. En premier lieu, le caractère non synchronisé du vieillissement de la population au niveau mondial influence les ajustements macroéconomiques sur longue période. En second lieu, le niveau d'incertitude démographique se révèle différent selon les régions, ce qui est susceptible d'affecter la dynamique des principales variables macroéconomiques.

Dans cette étude, nous analysons les conséquences de l'incertitude démographique dans un modèle d'équilibre général mondial à générations imbriquées (INGENUE 2). Dans un premier temps, nous réalisons des simulations stochastiques de population pour les dix régions du modèle à l'horizon 2050. Celles-ci nous permettent d'assigner des probabilités aux différentes trajectoires de population. Dans un second temps, nous introduisons ces simulations de population dans le modèle économique INGENUE 2 afin d'analyser leurs conséquences macroéconomiques sur la période 2000-2050. Nous illustrons ainsi comment l'incertitude démographique se transmet aux principales variables macroéconomiques (taux de croissance du PIB, taux d'intérêt mondial…).Nous montrons également que les hypothèses relatives au degré de corrélation des erreurs de prévision démographique entre les régions sont cruciales : elles conditionnent l'ampleur de l'incertitude économique et elles affectent les ajustements macroéconomiques à l'œuvre dans le modèle. En particulier, le comportement d'épargne des ménages dans ce modèle à générations imbriquées diffère substantiellement selon le degré de corrélation interrégionale des erreurs de prévision démographique, avec des conséquences sensibles sur la configuration mondiale des soldes courants.

Non-technical summary

While demographics have long been identified as a key variable in long term macro-economic analysis, most previous analyses have relied on deterministic population forecasts. But, as several recent papers testify, demographic developments are uncertain, and attempts at describing this via scenario-based variants have serious shortcomings. Macroeconomic consequences of demographic uncertainty have not been explored in a multi-regional setting of the world economy so far, but they can be of considerable interest. The asynchronous nature of the ageing process is expected to influence macroeconomic trends, but it is also of interest that the uncertainty of population forecasts differs across world regions

In this paper, we investigate the impact of demographic uncertainty in a multi-regional general equilibrium, overlapping generations model (INGENUE 2). Specifically, we will consider the level of uncertainty in each of the ten major regions of the world, and their

correlation across regions. In order to address these issues, we produce stochastic simulations of the world population for the ten regions until 2050. Then, we will analyse the economic consequences on a path by path basis over the period 2000-2050.

The stochastic simulations of population allow us to assign probability to the different population paths that we generate. The economic simulations performed with the INGENUE 2 model allow us to assess the uncertainty induced into key macroeconomic variables, the GDP growth rate and the world interest rate in particular, by uncertain future demographics. We show that the assumptions regarding interregional correlations of forecast errors are crucial in this multi-regional model: they have a large impact on the uncertainty of the macroeconomic variables: we illustrate this point by focusing on the world interest rate dynamics. Furthermore, it appears that the macroeconomic adjustments can differ substantially if we consider independence or high correlation across the regions. In particular, the macroeconomic behaviour of the agents in the current account/saving problem differs significantly across regions according to the degree of interregional correlation.

1. Introduction

Demographic projections suggest that the OECD countries (notably Europe and Japan) are expected to have large increases in their old-age dependency ratios. The other regions of the world are expected to have relatively low ratios, and their working age populations are expected to increase. This differential timing of ageing may induce international flows of "excess" saving from the ageing industrialised regions to the younger developing regions, during the next decades. We expect that such macroeconomic dynamics - more precisely the saving-investment equilibrium - are reflected in the world financial markets, in particular in the evolution of the world interest rate.

While demographics have long been identified as a key variable in long term macro-economic analysis, most previous analyses have relied on deterministic population forecasts. But, as several recent papers testify (e.g. Keilman, Cruijsen and Alho, 2007; Alho, Cruijsen and Keilman, 2007), demographic developments are uncertain, and attempts at describing this via scenario-based variants have serious shortcomings. As far as we know, macroeconomic consequences of demographic uncertainty have not been explored in a multi-regional setting of the world economy so far, but they can be of considerable interest. The asynchronous nature of the ageing process is expected to influence macroeconomic trends, but it is also of interest that the uncertainty of population forecasts differs across world regions (National Research Council, 2000).

In this paper, we investigate the impact of demographic uncertainty in a multi-regional general equilibrium, overlapping generations model. Specifically, we will consider the level of uncertainty in ten major regions of the world, and its correlation across regions. In order to address these issues, we produce stochastic simulations of the world population by the ten regions until 2050. Then, we will analyse the economic consequences on a path by path basis over the period 2000-2050.

These simulations allow us to assess the uncertainty induced into key macro-economic variables, the GDP growth rate and the world interest rate in particular, by uncertain future demographics. We will show that the assumptions regarding interregional correlations of forecast errors are important in our model: they have a large impact on the uncertainty of the macroeconomic variables, and it appears that the macroeconomic adjustments can differ substantially if we consider independence or high correlation across the regions. In particular, the macroeconomic behaviour of the agents in the current account/saving problem differs significantly across regions according to the degree of interregional correlation.

We start out by describing the main features of the point forecast for the world population, and focus then on both methodological and empirical aspects of the stochastic forecast of the world population (section 2). A non-technical overview of the economic model INGENUE 2[4] follows (section 3). Then we discuss our results on the world interest rate and the role played by the degree of interregional correlation (section 4). We conclude in section 5.

2. Stochastic Population Forecasts at the World Level.

In order to produce point forecasts of population by region, we rely on the demographic block of INGENUE 2. The world is divided into ten regions, mainly according to geographic, or cultural proximity[5]: *North America* (including Australia and New Zealand), *Western Europe* (approximately EU15)*, Japan, Eastern Europe* (including mainly the newcomers in the EU)*, Russian region* (including also Ukraine, Bielorussia and Central Asia), *Chinese region* (China and other East Asian countries excluding Japan*), Indian region* (India, Indonesia, Pakistan, Bangladesh, Sri Lanka), *Latin region* (South and Central America and the Caribbean),

---

[4] The INGENUE 2 model was developed at CEPII, CEPREMAP and OFCE by Michel Aglietta (CEPII), Vladimir Borgy (Banque de France and CEPII), Jean Chateau (OECD), Michel Juillard (CEPREMAP), Jacques Le Cacheux (OFCE), Gilles Le Garrec (OFCE) and Vincent Touzé (OFCE). See Ingenue (2007) for a description of the model.

*Mediterranean region (*Non-European Mediterranean countries, Near and Middle Eastern countries), and *Africa* (Sub-Saharan Africa).

2.1. Main Features of the Point Forecast.

The regional point forecasts of population have been specified to match the UN forecasts from 2000 to 2050[6], by age and sex. Using 1995 as the jump-off year, we project mortality by age and sex, and fertility by age, for each region, in 1995-2050. We assume that there is no migration across regions. Although this assumption is violated by a number of pairs of regions, relative to the sizes of the regions the migration flows are small. Changes in fertility and mortality rates are specified to match assumptions concerning the total fertility rate and life expectancy at birth.

According to the point forecast, the world population reaches 9.3 billion in 2050 (United Nations 2001). The population of the Indian region grows to 2.9 billion in 2050 (31% of the world population, against 28% in 2000). The population of the Chinese region increases slowly until a peak in 2050. Its share of the world population decreases from 27% in 2000, to 22% in 2050. Or, over the next 50 years, the Indian region is expected to grow by 70%, whereas the Chinese region will grow by 25%. The African region is expected to grow the fastest due to its high fertility. In contrast, the population of Western Europe is expected to stay at the current level, so its share will decline from the current level of 6.4% to 3.5% in 2050.

Western Europe and Japan are expected to be the first regions to undergo severe aging. In Japan, an increase in life expectancy coincides with a collapse of fertility (to 1.4 children per woman in 1995, against 2.0 in the U.S. and 1.7 in Europe). This leads to a decline of the working-age population, in 2005. Western Europe is also expected to undergo ageing as its dependency ratio (defined in this paper as the number of retirees in percentage of the total

[5] See the Appendix for a detailed definition of world regions in the INGENUE 2 model.

working age population) will rise substantially in the next decades (see Figure 1). In contrast, in North America fertility is expected to remain above 1.9 children, so the population is close to reproducing itself. There, the working-age population begins a slow decline in 2020.

Figure 1 shows that the Chinese region, Eastern Europe and the Russian region are also characterised by rapid ageing, which is expected to be even more pronounced in some countries than in Western Europe.

Figure 1. Point forecast of the dependency ratio (retirees in percentage of total working age population) in 2000-2050.
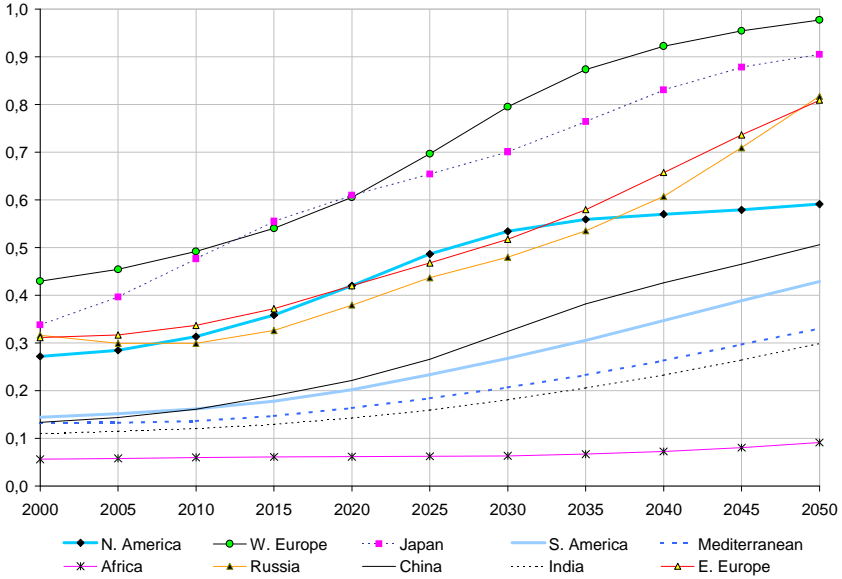
Source: INGENUE 2.

We concentrate first on the share of the 45-69 years olds by region, because high savers are concentrated in these ages. Figure 2 shows that the proportion of high savers propagates from one region to the next over time. The proportion reaches a peak in Japan in 1995 and remains high until 2030. Then, North America has a maximum in 2025, Western Europe in 2030, and Eastern Europe, the Russian region and the Chinese region follow. All are regions with declining labour force, which hampers future growth. In contrast, the potentially fast-growing regions are expected to see an increase in the proportion of high

---

[6] As discussed by Keilman and al. (2007), this probably understates the speed of aging somewhat.

savers, which does not culminate before 2050. It follows that saving is expected to change from early high savers to late high savers in the coming decades. This is because according to the life cycle hypothesis net savings should even out when cohorts reach the highest ages (Modigliani, 1986). This assumption is central to the saving behaviour of households in INGENUE 2.

Figure 2. Point forecast of the proportion of the high saver population (age group 45-69 years as percent of total population) in 1960-2050.
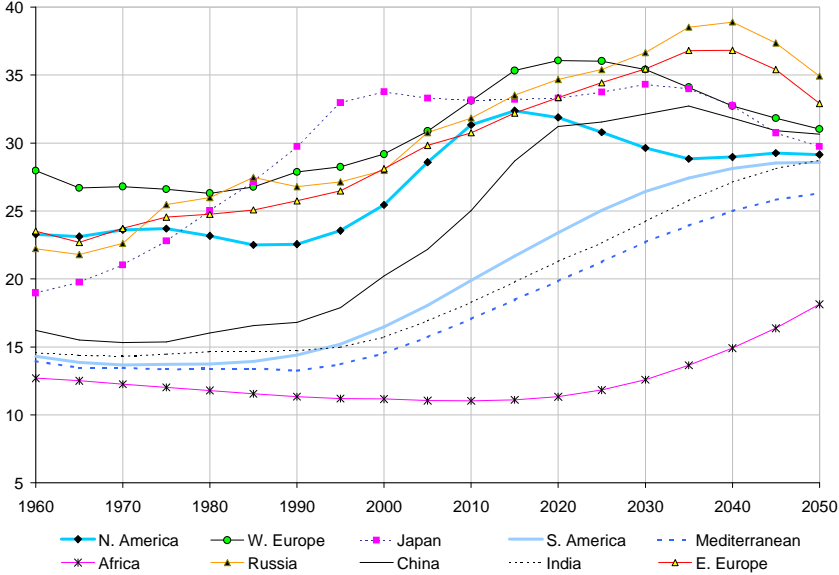
Source: INGENUE 2.

2.2. Deterministic vs. Stochastic Forecasts.

Revision of population forecasts over time common practice and reflect the uncertainty surrounding demographic projections (see Figure 3). For instance, between 1994 and 2000, the UN predicted a total population in Western Europe that vary slightly around 350 million people in 2050. Then the UN undertook a sharp upward revision, mainly driven by an upward revision concerning the assumptions for life expectancy and net migration, delivering a forecast of 400 millions in its latest 2004 projection. Eurostat gave an almost identical number

the same year after a substantial upward revision. However an alternative forecast performed by independent demographers in the frame of the European project UPE[7] on the basis of stochastic population forecasts gives a higher number of 427 millions[8]. The difference is primarily due to an assumption of faster decline in mortality, and higher level of net migration. Both can be justified by considering biases in past official forecasts.

Figure 3. Forecasts of total population size for EEA countries in 2050
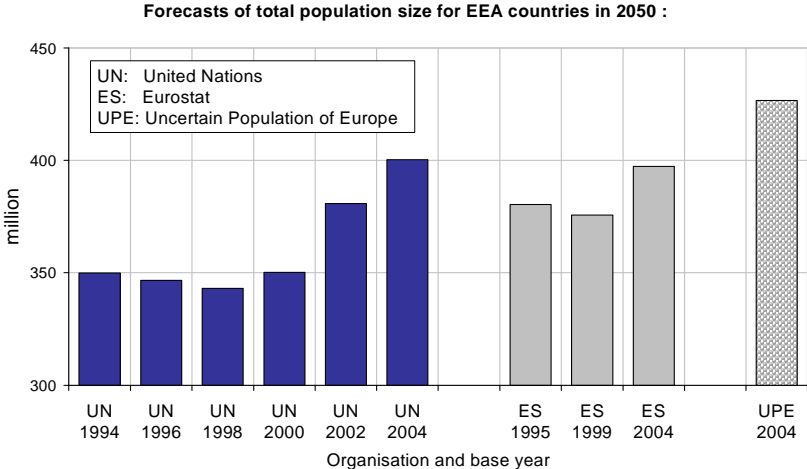
Sources: UN, Eurostat and UPE.

To make a conventional cohort-component population forecast, one specifies age-specific fertility rates for women, and mortality rates for women and men for all future years of the forecast. These inputs are used to generate births and deaths. Furthermore, net migration, most often specified in absolute numbers, is added to the population each year. Since the future rates are known only after the fact, demographers have traditionally used alternative (high and low) variants that bracket the point forecast. These are computationally simple to produce. Yet, this approach has several important shortcomings as a means of describing forecast uncertainty.

---

[7] See the UPE website for information about the UPE forecasts : http://www.stat.fi/tup/euupe/
[8] See Alders, Keilman and H.Cruijsen (2006).

First, there is not, in general, any guarantee that the high and low variants for fertility correspond to a similar level of uncertainty as the high and low variants for mortality. When expressed in probabilistic terms, it might well happen that the high-low intervals for mortality have a much higher chance of covering future values than the high-low intervals for fertility, for example. Nor is it there any guarantee that the high and low variants for different ages, or for different future years, correspond to the same level of uncertainty. Without a quantitative yardstick, it is difficult – essentially impossible – come up with a set of high-low intervals that would be consistent in the probabilistic sense.

Second, a more subtle, logical difficulty arises from the use of high and low variants. For example, when the high variant of fertility is assumed to persist for every age and for all future years, the method does not allow for any fluctuations that would cancel to some extent, over age and time. However, it is known empirically that forecast errors of vital rates do show a fair degree of cancellation. It is even more obvious that the reasons for why errors incur in mortality forecasts are typically quite different for the reasons error in fertility or migration forecasts. For example, France, Spain and Italy have shared similar trends in mortality during the past decade or two, but their fertility and migration trajectories have been quite different. From a probabilistic point of view, the use of high and low variants as descriptors of uncertainty is equivalent to an assumption of perfect correlation that is empirically known not to hold[9]. These are some of the reasons, why stochastic forecasts have been proposed as a more consistent method of describing the uncertainty in population processes.

Stochastic cohort-component forecasts are formally similar to conventional population forecast, but now future fertility and mortality rates and net migration are considered as

---

[9] This does not mean that alternative variants could not serve other useful purposes. For example, well-motivated economic scenarios can be used as a foundation of population developments without any references to the likelihood that scenarios might, or might not, materialize.

random variables[10]. Although the history of stochastic population forecasts goes back 50 years or more, their development was greatly boosted by the phenomenal increase of the speed of computing that has taken place during the past three decades. In particular, the ability to use stochastic simulation has allowed the use of realistic model that avoid simplifications that are necessary for analytical tractability.

2.3. Stochastic Forecasts of the World Population: Methodological Issues

For each region, the point forecast is used as input into PEP[11]. Since we assume no migration, the uncertainty of forecasting derives from fertility and mortality alone. As discussed in Alho, Cruijsen and Keilman (2007) a direct empirical assessment of forecast uncertainty is a practical possibility in many countries, notably in the EU. However, for the broad regions of the world, only partial estimates are available (e.g. Alho 1997). Thus, a different strategy had to be adopted.

To specify the uncertainty parameters we used two sources of information. First, as regards relative level of uncertainty across age and sex, we used the empirical estimates for the 18 European countries discussed by Alho, Cruijsen and Keilman (2007). Second, and more important, these estimates are proportionally calibrated to match the empirical findings concerning the overall level of uncertainty in population size, as given in Chapter 7 of the book '*Beyond Six Billion*' (National Research Council, 2000).[12] These estimates were obtained for the total population of all countries included in the world forecasts of the UN, and for broad regions of the world, during the latter part of the 20th century. In practice, we multiplied all age- and sex-specific uncertainty parameters by one region-specific constant

---

[10] The methodological features of stochastic population forecasts are explained in Alho, Cruijsen and Keilman (2007).
[11] *Program for Error Propagation*. A detailed description of the PEP program is available at http://www.joensuu.fi/statistics/juha.html.
[12] Some re-grouping of the countries had to be done to arrive at the final estimates for the work at hand.

such that the resulting coefficient of variation[13] of the total population of each region, for year 2050, agrees with the empirical estimate. The coefficients of variation that we used for the calibration of the uncertainty parameters are presented in Table 8.1. The interpretation is that the probability of, say, Japan being within ±13% of the point forecast in 2050 is about 2/3. As discussed in Alho and Spencer (2005), these estimates depend on the volatility of population development during the past half a century. For some regions (such as Western Europe and North America) this period has been relatively calm so level of uncertainty as specified in Table 1 is lower than estimates that are based on longer time periods. For others (such as the Russian region) the period may have been unusually turbulent.

Table 1. Coefficients of variation used for the calibration of the uncertainty scale parameters.

North America	Western Europe	Japan	South America	Mediterranean
0.06	0.05	0.13	0.12	0.24
Africa	Russian Region	Chinese Region	Indian Region	Eastern Europe
0.17	0.26	0.11	0.11	0.06

In a multi-regional setting, the question of the correlation between the stochastic population forecasts is of major interest. Referring to the stochastic forecast for the world population presented in '*Beyond Six Billion*', Alho and Spencer (2005) note that there were not sufficient data to reliably estimate correlations across the ten regions empirically. Yet, the world forecast is sensitive to the level of interregional correlation.

---

[13] I.e. standard deviation divided by the mean.

Given that reliable empirical estimates of correlation were not available, we ran stochastic simulations with PEP in such a way that we could perform sensitivity analyses[14] concerning the level of correlation of interregional forecasts errors. Technically, we relied on the use of seeds that has been implemented in PEP (see Chapter 9 of Alho and Spencer, 2005). For instance, if we want a positive correlation of 0.2 between regions, we first run the program PEP *4n/5* times with a different seed for each region and then *n/5* times with the same seed for all the regions. As a consequence, looking at the first 4*n/5* rounds of simulations allows us to analyse the case with the assumption of independence between the regions. By contrast, looking at the last *n*/5 rounds we can study the case of (essentially) perfect correlation. Results from the whole set of simulations (*n* times) allows us to study the case with a positive correlation of 0.2.

2.4. Stochastic Forecasts of the World Population: Main Results.

Figure 4 depicts a stochastic forecast for the world population on the basis of 400 simulations performed with 50 % and 95 % prediction intervals that assume (unrealistically) complete independence across regions and the UN high and low variants. The median of the predictive distribution for the world population in 2050 is 9.51 billion[15]. According to these estimates, there is a 50 % probability that the world population in 2050 is between 9.18 and 9.87 billion people.

---

[14] We compare the case of independence of interregional forecasts errors with the one where the correlation between regions is positive and could reach 0.2.

[15] In general, the median of the predictive distribution does not exactly agree with the point forecast. In addition, the calibration of the data for use in PEP was based on a number of simplifying assumptions. Finally, simulation error may contribute to the difference between 9.51 billion and the UN point forecast of 9.3 billion.

Figure 4. Stochastic forecasts of the world population (independence of interregional forecasts errors) and UN high/low variants.
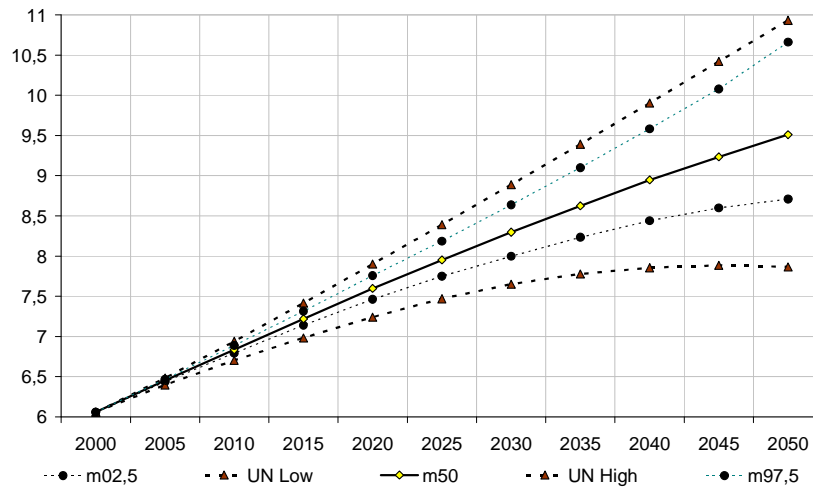
Sources: Authors' calculations and UN (2001) World Population Prospects.

Table 2 presents the uncertainty of the world forecasts in the case of independence across regions compared with the case where the interregional correlation is 0.1 and 0.2. Introducing an interregional correlation of 0.1 across the ten regions has an effect of multiplying the standard error estimates for the world by 1.19 as compared to standard errors that assumed independence[16]. With an interregional correlation of 0.2, the standard error estimates for the world is multiplied by 1.30 as compared to standard errors that assumed independence. With the assumption of independence between the regions, the 95% prediction interval is [8.71, 10.66] billion. With the assumption of the interregional correlation of 0.1, the 95% prediction interval is larger and ranges between 8.46 and 10.78 billion. The 95% prediction interval is even larger when we assume an interregional correlation of 0.2 as it reaches [8.21, 10.81] billion. The increase in the prediction interval is explained by the fact that when we consider a positive interregional correlation, we introduce a certain number of

---

[16] Based on extensive simulations Alho and Spencer (2005) find a multiplier of 1.28 for the standard error estimate for the corresponding analysis. The difference may be due to the limited number of simulations we have at our disposal.

simulations with perfect correlation (see Section 2.3). As a result, we get some "extreme" population paths in which the errors are going in the same direction for all the regions considered. One must note that, in all the cases, the UN high and low variants are outside from the prediction interval, illustrating that the probability they could occurred is very low[17].

Table 2. Quantiles of the predictive distribution of world population in 2050.

	0.025	0.25	0.5	0.75	0.975
Independence	8.71	9.18	9.51	9.87	10.66
Correlation of 0.1	8.45	9.15	9.50	9.87	10.77
Correlation of 0.2	8.23	9.12	9.50	9.89	10.89

Table 3 shows that Western Europe will age rapidly in the coming decades: the median of old-age dependency ratio is expected to increase from 0.50 in 2010 to 0.99 in 2050, with a 90% prediction interval of [0.88, 1.13]. A comparison to Table 4. indicates that the Russian region will age by as much, from 0.31 to 0.82 in 2050, but starting from a lower level. However, a major difference is that in the latter the 90% prediction interval ranges from 0.46 to 1.30 in 2050. Furthermore, notice that the dispersion is already high in 2030.

Table 3. Quantiles of the predictive distribution of the dependency ratio in Western Europe in 2010, 2030 and 2050.

	0.05	**0.25**	**0.5**	**0.75**	**0.95**
2010	0,49	0,50	0,50	0,50	0,50
2030	0,77	0,79	0,81	0,83	0,85
2050	0,88	0,95	0,99	1,04	1,13

Note: Results under the assumption that interregional errors are independent.

---

[17] One must note that Juha Alho reach a similar conclusion with the stochastic simulations presented in the

Table 4. Quantiles of the predictive distribution of the dependency ratio in Russian region in 2010, 2030 and 2050.

	0.05	0.25	0.5	0.75	0.95
2010	0,28	0,30	0,31	0,32	0,33
2030	0,33	0,43	0,50	0,56	0,63
2050	0,46	0,66	0,82	1,00	1,30

Note: Results under the assumption that interregional errors are independent.

3. INGENUE 2: A long term model for the world economy

Our economic simulations were made with a new version of the computable, general equilibrium, multi-regional overlapping-generations model INGENUE[18]. The model was initially constructed to assess wealth accumulation and the development of pension funds and other forms of retirement saving, in a global macroeconomic setting[19], for ten major regions of the world, until 2050.

INGENUE 2 is an overlapping-generations model of Auerbach and Kotlikoff (1987) type. The model has 21 generations. The time unit is 5 years and the maximum life span is 105 years. The model includes 17 cohorts of adults (ages 20+) and 4 cohorts of young (ages < 20). Cost per child is proportional to the consumption of their parents. Labour supply is exogenous and adjusted for an age-specific participation ratio to the labour market in each region. The model does not distinguish between sexes, the young do not optimise their behaviour, and household behaviour is reduced to behaviour of individuals who progress from working age to retirement age according to region-specific patterns.

'*Beyond Six Billion*' book.

[18] For technical features of the new INGENUE 2 model, as well as the baseline scenario and a sensitivity analysis of the main structural parameters, see Ingenue (2007).

[19] For a synthetic view on the global demographic changes issue, see IMF (2004) and Ingenue (2002). This issue is also explored in a multi-country model by Börsch-Supan, Ludwig and Winter (2006).

Household behaviour. Individuals make economic decisions according to the life cycle hypothesis. A voluntary bequest is left to children at age 80 (in the baseline version of INGENUE 2) subject to survival until 80. In the budget constraint, the expenditures consist of consumption (including costs of children) and saving in each age and each period. On the income side there is, first, the return on accumulated saving corrected by one-year survival probabilities. This adjustment is equivalent to a perfect annuity market that pools the risk of death. Second, there is non-financial income that depends on age: labour income (after social security taxes) adjusted by a region-specific age profile of labour force participation for people in full labour activity; a mix of labour income and pension benefits for people partially retired (reduced labour activity); full pension benefits for people entirely retired. The lifetime utility is maximised under the intertemporal budget constraint, taking prices, social contributions and benefits as given (Modigliani, 1986).

Public sector is confined to a public Pay-As-You-Go (PAYG) defined benefit pension scheme in all regions. It pays a proportion of the current net wage to retirees. It is financed by a payroll tax on labour income. The exogenous parameters are the retirement age and the replacement ratio. They are region-specific and the contribution rate is determined so as to balance the budget, period by period.

Production system. Goods are heterogeneous. In each region there is an intermediate goods sector. It uses labour and capital to produce a region-specific intermediate good with a constant return-to-scale Cobb-Douglas production function. The final goods sector is the product of a Constant Elasticity of Substitution (CES) combination of a domestic intermediate good and an homogenous world good imported by the region from a world market (Backus and al., 1995). This homogenous world good is "produced" by a fictive world producer as the output of a CES combination of all intermediate goods exported by the regions. All production functions are augmented by Total Factor Productivity (TFP) coefficients.

Firm behaviour. In each sector (intermediate/final goods), markets are competitive. Firms maximize their profit under their production constraint, taking prices as given. In the domestic intermediate good sector the constraint is intertemporal, since the production function depends on the stock of capital that is depreciated and accumulated. Intermediate goods producers maximize net present value of future cash flows, i.e. production value minus wage cost and capital cost. The latter depends on the depreciation rate, which is itself influenced by international capital market imperfections. The depreciation rate is asymmetrically dependent on the ownership ratio (total wealth of households/ capital stock). An ownership ratio less than one indicates that the region is a net debtor. In those regions the imperfections of international financial markets raise the cost of capital the more the larger foreign debt. It shows up in a higher rate of economic depreciation of the capital stock. In creditor regions (ownership ratio above one) the rate of depreciation is a constant, thus independent on financial condition. Other types of producers face a simpler maximisation problem. Domestic goods producers and the world producer maximize current profit subject to their CES production functions.

General equilibrium. The capital stock in each region, the age distribution of saving in each region, and the initial prices of domestic commodities, are the initial conditions. Exogenous variables and parameters are the demographic profiles in each region that are outputs of the demographic upstream model; the coefficients of the TFP determination in intermediary and final sector of each region; and the social security policy parameters in each region. The competitive world equilibrium stems from five set of equations: intertemporal utility maximization of households; intertemporal profit maximization of firms in intermediate goods sectors; period profit maximization of firms in final goods sectors; period profit maximization of the world producer; and market clearing conditions. The markets for intermediate goods, final goods, labour in each region, and the market for the world

intermediate good, are cleared in each period. These equations determine all relative equilibrium prices expressed in a common *numeraire*, which is the price of the intermediate good in North America. This convention allows us to express values in constant dollars. Finally, Walras's law implies that the world financial market equilibrium is the redundant equation.

Technological catching up. The level of TFP is exogenous and grows at a constant rate, in each region. For 1950 until 2000, the growth rate of TFP is given by historical data. After this date the rate of growth of the TFP is the result of a given, exogenous growth of 1.1% per annum in the North American region, supposed to be the technological leader, and a region-specific exogenous, catching-up factor, reflecting international diffusion of technological progress. In the baseline scenario of the model, three regions have a sustained catching up process: the takeoff in the Chinese and Indian regions which had already started in the 1990's is assumed to gain momentum. Eastern Europe is also assumed to be a fast growing region due to its participation to the European Union. The model has been calibrated on the basis of the international macroeconomic database constructed by Heston, Summers and Aten (2002).

4. Macroeconomic consequences of demographic uncertainty in a multi-region model.

In this section, we analyse the economic consequences on a path by path basis of the introduction of the stochastic simulations of the world population.

4.1. Macroeconomic consequences of regional demographic uncertainty.

The macroeconomic consequences of demographic uncertainty are different from one region to another (Table 1). For instance, the uncertainty surrounding the GDP growth rate is higher for the Russian region than for the Western European region of the model as a result of the

higher uncertainty concerning the populations forecasts in the former region (Tables 5 and 6). The median of the predictive distribution of GDP growth decreases in Western Europe from 1.90% in 2010 to 0.67% in 2050 with a 90% prediction interval of [0.31 %, 1.04 %]. In the Russian region the median decreases sharply from 1.60% in 2010 to 0.08% in 2050. The uncertainty is substantially higher than in Western Europe with a 90% prediction interval of [-1.11 %, 1.17 %]. In the INGENUE 2 model, demographic uncertainty translates into economic uncertainty through two channels: first, uncertainty on the size of the working age population impacts directly GDP growth in each region. Second, GDP growth also reflects the consumption/saving choices of the households with perfect foresights who react to new population paths they discover at the beginning of the simulation period. This last point explains why uncertainty surrounding GDP growth in the Russian world is already high at the beginning of the 21st century.

Table 5. Quantiles of the predictive distribution of GDP growth in Western Europe in 2010, 2030, and 2050.

	0.05	**0.25**	**0.5**	**0.75**	**0.95**
2010	1.85	1.88	1.90	1.92	1.94
2030	0.57	0.61	0.64	0.68	0.72
2050	0.31	0.52	0.67	0.80	1.04

Table 6. Quantiles of the predictive distribution of GDP growth in the Russian region in 2010, 2030, and 2050.

	0.05	**0.25**	**0.5**	**0.75**	**0.95**
2010	1.20	1.45	1.60	1.73	1.85
2030	0.15	0.65	0.84	0.99	1.14
2050	-1.11	-0.44	0.08	0.58	1.17

In the INGENUE 2 model, the world interest rate balances at each period the capital supply and the capital demand at a world level. The equilibrium of the world financial market is then given by the following equation:

$$\sum_z p_f^z(t)K^z(t) = \sum_z p_f^z(t)S^z(t),$$

Or, at time t the world interest rate will balance the sum over all regions z, of firms' capital stocks $K^z(t)$ and assets (hold by the households) $S^z(t)$, where $p_z^f(t)$ denotes the price of the final good produced in region z at t. As a theoretical 'balancing parameter', the interest rate does not exactly correspond to observable interest rates. Probably the closest proxy for the rate would be the real US bond yield rate of AAA companies. However, as our model assumes perfect foresight, the world interest rate we consider is not perturbed by structural shocks of the world economy, changes in monetary policy etc. In fact, the only source of variation considered in this paper is that caused by changing demographics.

In the deterministic baseline scenario, the world interest rate is expected to decline in the next fifty years as a result of the demographic evolution and the macroeconomic dynamics: the working age population is expected to decline absolutely while the age-group of high savers is expected to grow in one region after another (Figure 2). In the first decades, there is a substantial amount of saving by the ageing populations of Western Europe and Japan. In the long run, saving will diminish but increase in the developing regions, where investment will become more efficient due to technological catching up. As a result, the world saving-investment equilibrium is tilted more and more towards a lower equilibrium rate.

Introducing stochastic demographics into the economic model does not substantially change the picture: the general declining pattern of the world interest rate remains the same. The uncertainty related to this economic variable increases over time but remains quite low (see Table 7).

Table 7. Quantiles of the predictive distribution of the world interest rate in 2010-2050.

	0.025	0.25	0.5	0.75	0.975
2010	6,582	6,635	6,661	6,683	6,731
2020	5,267	5,346	5,384	5,421	5,505
2030	4,531	4,648	4,702	4,759	4,887
2040	4,193	4,333	4,397	4,479	4,646
2050	3,889	4,059	4,136	4,241	4,415

Introducing an interregional correlation of 0.2 across the regions increases the standard deviation of the world interest rate, but the effect becomes smaller with the forecast horizon (Table 8). In 2010 the standard deviation is multiplied by 1.37 but in 2040 only by 1.14.

Table 8. Dependence of standard deviation of world interest rate on interregional correlation of population uncertainty:

|	2010	2020	2030	2040	2050
Ratio	1,375	1,288	1,163	1,143	1,079

Note : Ratio = (standard deviation when interregional correlation is 0.2)/(Standard deviation when region are independent).

These results contrast with those obtained with the GDP growth, above. In particular, we conjecture that the narrowness of the prediction intervals for the world interest rate is primarily due to the assumption of perfect foresight of the agents.

In order to analyse the effects of demographic uncertainty on the world interest rate, we compute three "global" old-age dependency ratios. The G3 dependency ratio includes the three most industrialised regions of the model, namely Western Europe, North America and Japan. The G5 dependency ratio includes Western Europe, North America, Japan, East

Europe and Russian Region that are expected to experience the most important ageing over the next five decades. The world dependency ratio includes all ten regions.

Figure 5. World interest rate as a function of the G3 dependency ratio in 2025 under the assumption that interregional forecasts errors are independent.
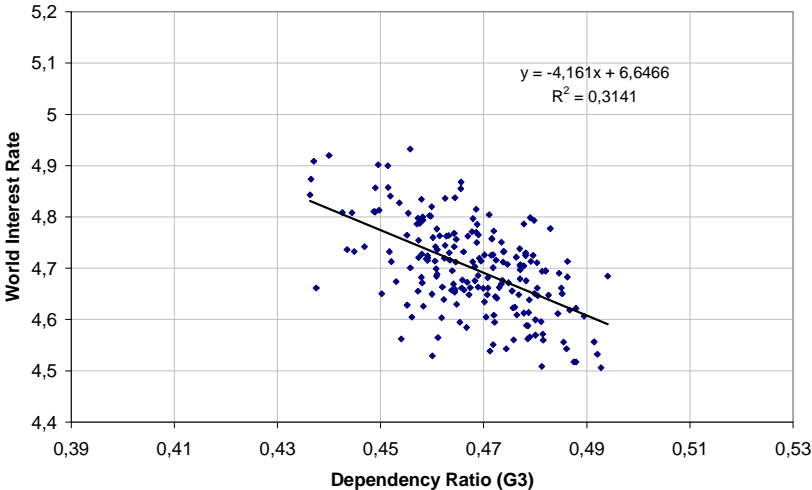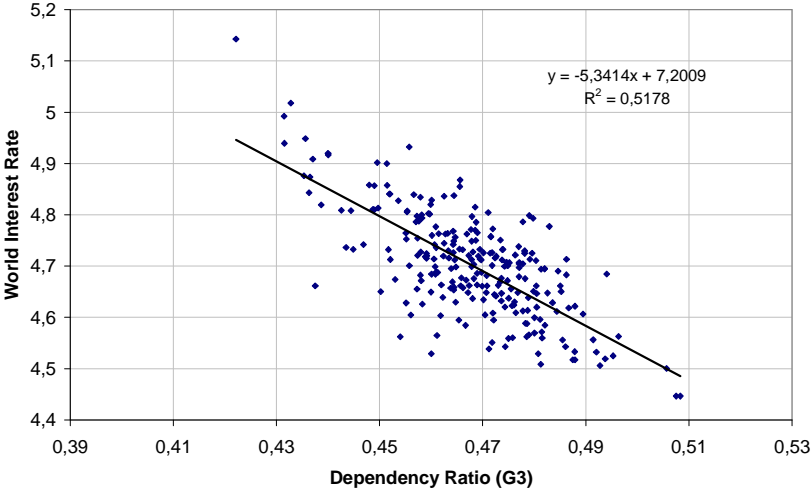

Sources: Authors' calculations.

Figure 5 depicts the G3 old-age dependency ratio and the world interest rate in 2030 for the case where interregional forecasts errors are independent (based on 200 simulations). There is a clear negative correlation between the dependency ratio and the interest rate ($R^2 = 0.31$). To understand this economically, note first that a higher than expected old-age dependency ratio reflects either a high number of elderly people, a low number of working age people, or both. Consider first the case of an unexpectedly low number of workers[20]. In our economic framework investment is taken to be an increasing function of the working age population, so we expect a decline in demand for investment capital. This tends to lower the interest rates. Consider now the case in which we have a higher than expected number of the elderly[21]. Under the assumption of perfect foresight, workers will save more, all through their careers, than under the most likely circumstances. Thus, there will be an increase in the

---

[20] As discussed in Alho et al. (2007), this occurs typically if our forecast of net-migration is too high.

supply of capital to the markets, and interest rates will again go down. On a longer horizon, the macroeconomic effects of a higher than expected number of the elderly will be different. As they retire, individuals will sell their assets to finance consumption: the lower amount of assets will induce an increase of the interest rate. As the share of the elderly population increases over time, the macro-level of saving will decrease and the interest rate will then rise.

Figure 6. World interest rate as a function of the G3 dependency ratio in 2025 under the assumption that interregional forecasts errors have a correlation of 0.2.

Sources: Authors' calculations

The link between the world interest rate and the G3 old-age dependency ratio is reinforced when we assume a positive correlation for the interregional forecasts errors. Figure 6 depicts the G3 dependency ratio and the world interest rate in 2030 for the case where interregional forecasts errors have a positive correlation of 0.2.[22] By comparing this result with the previous one, we note that the dispersion of the dependency ratio is higher. This result from the fact that we now take into account simulations with interregional forecasts errors that have a positive correlation (i.e. stochastic simulations of populations with low

---

[21] This would typically be caused by mortality being lower than we expect in the baseline scenario.

25

fertility rate and/or higher life expectancy for one region is associated with stochastic simulations with the same characteristics for the nine remaining regions). Furthermore, the scatter of the world interest rate is also higher than in the case where interregional forecasts errors are independent[23]. Or, the positive correlation between regions leads to economic situations where the tensions on the world capital market are substantial.

The G3 old-age dependency ratio is perhaps the most accurate 'global old age' variable of the three that we have considered for the purpose of explaining the level of world interest rate in 2030 as it has $R^2 = 0.52$ (Figure 8.5). Indeed, when interregional forecasts errors have a positive correlation of 0.2, the R^2 of the regressions of the world interest rate on the G5 and world dependency ratios are equal to 0.37 and 0.38, respectively.

In order to have a deeper understanding of the effect of cross-regional correlation of demographics on world interest rate, we look at the simulation leading to the lowest level for world interest rate in 2030. This occurred under a perfect correlation simulation. In it, fertility is globally lower than in the point forecast, leading to a lower growth rate of the working population of the regions from 2030 (Figure 7).

---

[22] Technically, the 50 simulations of stochastic populations that have been performed with PEP by taking the same seed for the different regions of the model are added to the 200 independent simulations.

[23] This result has already been highlighted in Table 8.8.

**Figure 7. Working age population annual growth rate in 1995-2050 (difference from baseline scenario).**
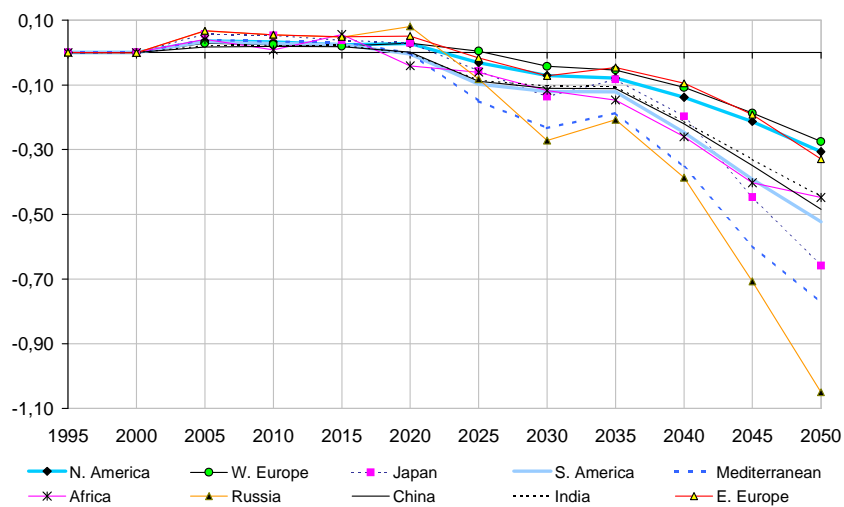
Also, life expectancy is higher than in the point forecast, so the old-age dependency ratio, the contribution rate to the retirement system, and the proportion of high savers are substantially higher than under the point forecast, in the developing regions of the model. Over the period 2000-2030, the increase of saving is the highest in the regions facing the most important rise of their dependency ratio. Thus, the supply of capital from households is high for all regions during 2000-2030 (see Figure 8.7)[24]. The lower labour input leads to lower investment and a lower GDP growth after 2035. This lowers the demand for capital from firms. Over the whole period, the interest rate resulting from this saving-investment equilibrium is lower than under the most likely population development, because the global capital supply exceeds the capital demand in all regions.

Figure 8. Evolution of the Net Saving (in percentage of GNP):

difference from baseline scenario
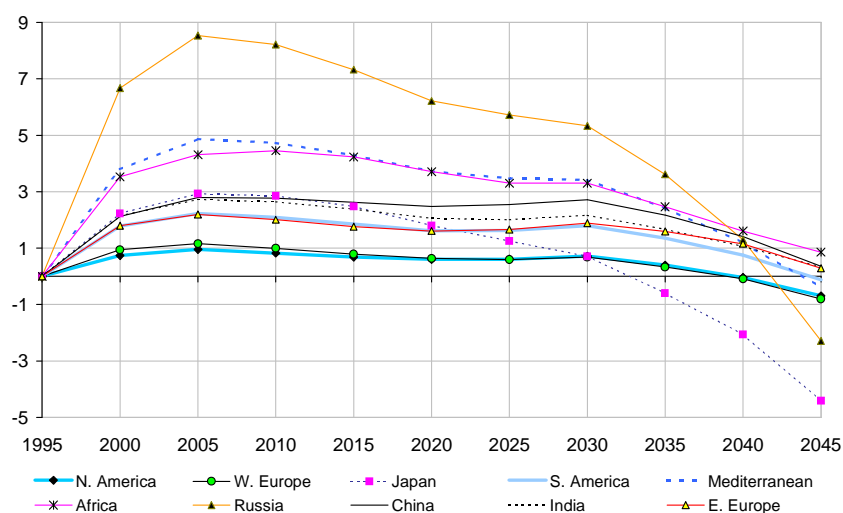
4.2. Macroeconomic dynamics with perfect interregional correlation vs. independence.

We have seen that the macroeconomic behaviour of the agents in the regions is related to the degree of interregional correlation. In order to illustrate this point we focus on the current account/saving problem for Western Europe, North America and Japan on the one hand, Chinese and Indian regions on the other.

In 2025[25], industrialised regions have begun to experience ageing: the old-age dependency ratio of Western Europe is expected to increase to 0.7 from 0.45 in 2005, and in Japan it is expected to rise to 0.65 from 0.40 in 2005 (Figure 1). Although the ageing process is less pronounced in the two Asian regions, the dependency ratio is still expected to increase by almost 0.10, reaching 0.26 in 2025 in the Chinese region. In the Indian region, the increase is expected to be much less pronounced as the ratio increases only by 0.04 during 2005-2025

---

[24] Overall, the deviations from the baseline scenario are the largest for the regions where the uncertainty scale parameters have the highest calibrated values (see Table 1).

to reach 0.16. According to the point forecast, the proportion of high savers would reach its peak in 2020-2025 in Western Europe (Figure 2). At this time, the proportion of high savers will be high in Japan[26], but also in the Chinese region and North America. In 2025, the proportion of high savers is expected to have increased in the Indian region but to remain below 25% of the total population. From the economic point of view, in 2025 the three industrialised regions are creditors *vis-à-vis* the rest of the world, because they all have current account surpluses. In contrast, the two Asian regions are net borrowers (Figure 9).

Indeed, our analysis shows that Western Europe could get a current account surplus: the saving of European households could flow towards the developing regions of the world that have a more sustained path of growth, due to the increase of their working age populations. Nevertheless, these regions will also face fiscal sustainability problems in relation with ageing in a more distant future (Figure 1).

Figure 9. Evolution of Current Account Balance in the INGENUE 2 model

(percentage of World GDP) .
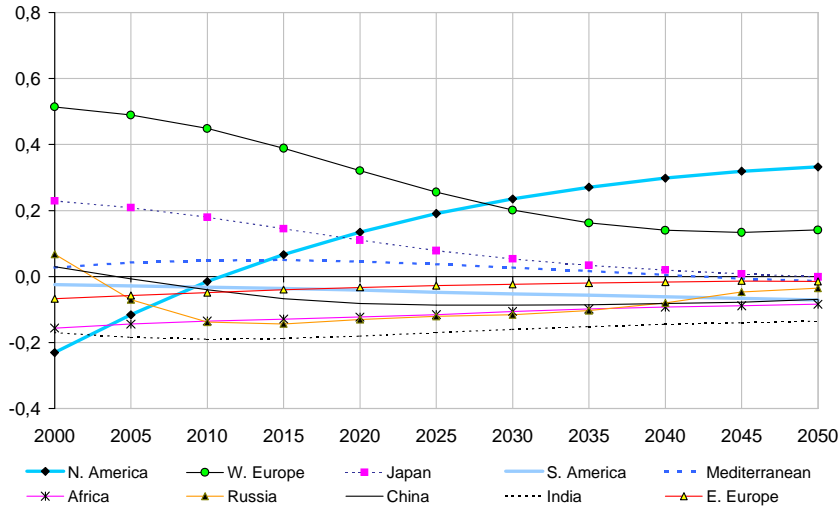
Source: INGENUE 2.

---

[25] The results are similar for the decade 2020-2030, but they would differ for more distant periods as the relative demographic and economic features of the regions change.

Our simulations highlight the potential effect of cross-regional correlation on macroeconomics. For instance, there is a clear positive association ($R^2 = 0.72$) between the current account position and the level of saving in Western Europe in 2025 (see Figure 10) when regional demographics are independent. The level of saving depends on population structure that differs from one population simulation to another. A high level of national saving will allow the Western European region to have a more pronounced creditor position *vis-à-vis* the rest of the world. In the case in which cross-regional correlation is 0.2, the association is less important (the $R^2 = 0.60$).

Figure 10. Current Account as a function of Saving in Western Europe in 2025 under the assumption that interregional forecasts errors are independent.

$$y = 0{,}1871x - 1{,}4235$$
$$R^2 = 0{,}7219$$
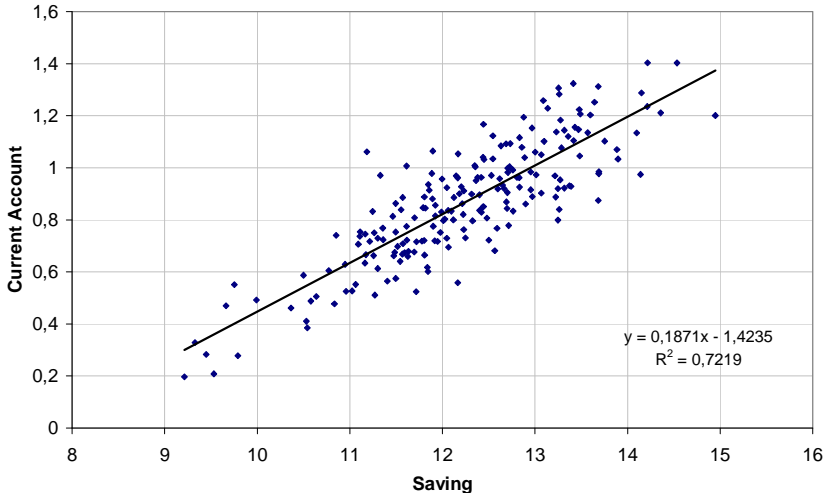
Sources: Authors' calculations.

In order to understand this result, we plot in Figure 11 the current account and the level of saving in the case with perfect correlation for the interregional forecasts errors[27]. The correlation between the economic variables is now negative. This is caused by behavioural

---

[26] The proportion of high savers also reaches high values in Eastern Europe and the Russian region, two regions that will also experience ageing and fiscal sustainability problems at this time horizon.
[27] This corresponds to the stochastic simulations performed with the same seed for all the regions of the model.

adjustments of the economic agents[28]. Indeed, the correlation between saving across two regions is high in the case of perfect correlation. For instance, the regression of saving in North America on saving in Western Europe in 2030 shows a high positive correlation: $R^2 = 0.841$ and the regression coefficient is equal to 1.11 (in the case of independence of interregional forecasts errors, the $R^2 = 0.127$ only)[29]. This statistical result concerning saving in the case of perfect correlation is observed for all the regions. For instance, for regression of saving in Western Europe on saving in the Indian Region in 2030 we have $R^2 = 0.67$, reflecting a high positive correlation in the case of perfect interregional correlation, while it is equal to zero in the case of independence between the region.

Figure 11. Current Account as a function of Saving in Western Europe in 2025 under the assumption that interregional forecasts errors are perfectly correlated.

$y = -0,3454x + 5,1094$
$R^2 = 0,6404$
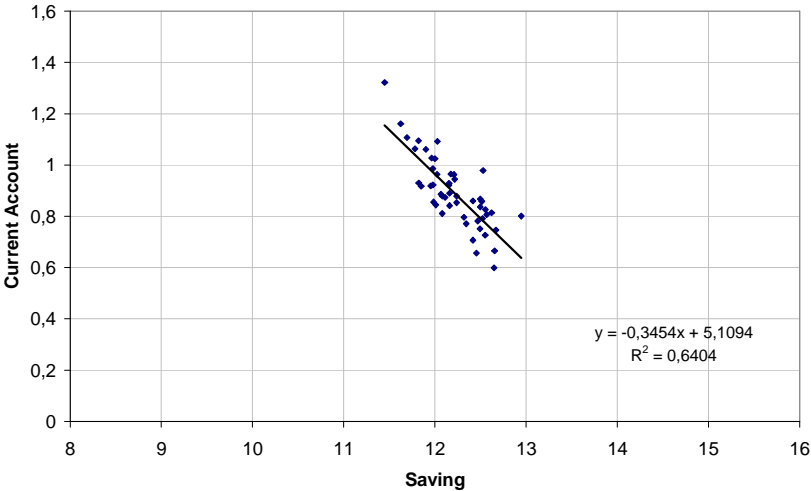
Sources: Authors' calculations.

---

[28] We note that the same regression based on the current account and saving in the North American region in 2025 leads to the same results. In the case of Japan, there is a clear positive correlation in the case with independence of interregional forecasts errors but there is no correlation in the case of perfect correlation between the regions of the model.
[29] One must note that the regression of the dependency ratio of Western Europe on the dependency ratio of North America show a very high positive correlation (0.99) in the case of perfect correlation. In the case of independence, the correlation is equal to zero.

The phenomenon we observe is caused by the fact that, for each simulation, deviations from the point forecast go to the same direction for all regions (Figure 7 illustrates this for the working age population). As a consequence, once the decision makers discover the non-anticipated new population path in 2000, households in each region will change their consumption/saving behaviour in the same way. For instance, while the households of a region will increase their saving during their working period if life expectancy is higher than in the point forecast, the same will happen in other regions, as well. Therefore, the amount of capital exported by these regions (inducing a current account surplus) is not a function of the level in their national saving as in the case of independence between regions. To illustrate this further, we focus on the Indian region. In the case of independence between the regions, we observe the same statistical relation than for the Western Europe case (Figure 12). The current account deficit of the Indian region is all the more important than the level of saving is low in the region.

Figure 12. Current Accounts vs. Saving in the Indian region in 2025 under the assumption that forecast errors are independent.
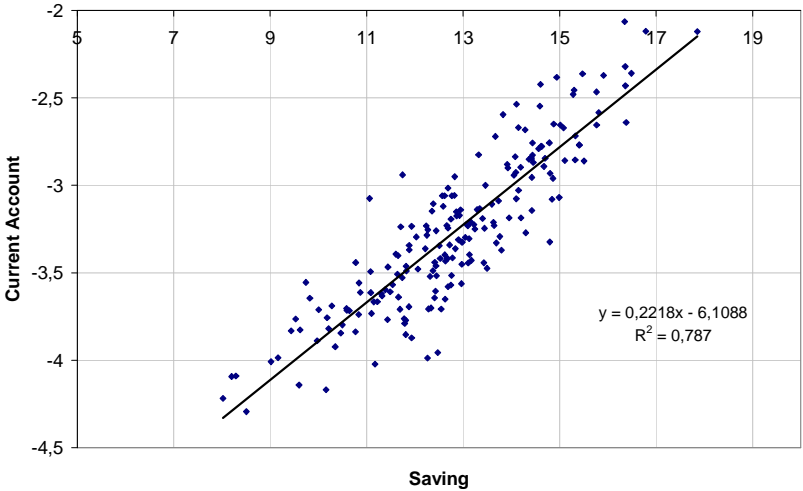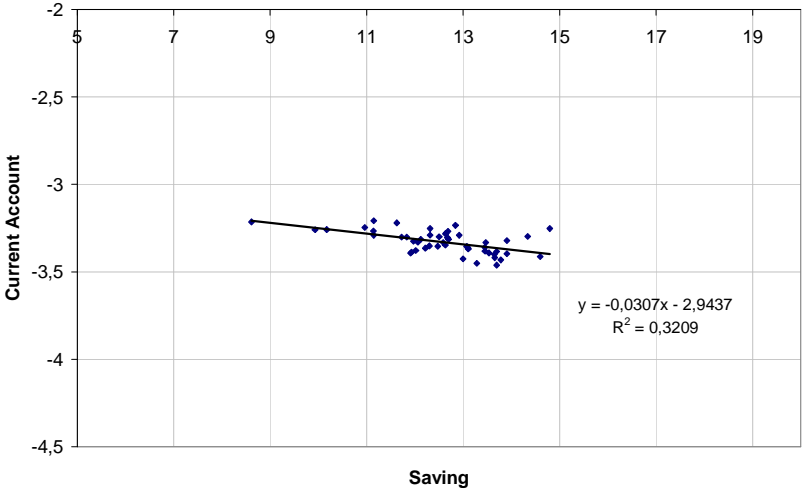

Sources: Authors' calculations.

In the case with perfect correlation across the regions, this positive correlation does not hold anymore (Figure 13): the coefficient associated with the regression (which is equal to 0.22 in the previous case) is now equal to –0.03. Furthermore, the range of current account deficit is much narrower than in the case with independence[30].

It appears that the external position of the Asian regions (Chinese and Indian regions) is less sensitive to the level of their saving in the case with perfect interregional correlation. The link between the macroeconomic variables in this multi-regional setting is then distorted in the cases in which all the regions face the same type of innovations concerning their population paths.

Figure 13. Current Account vs. Saving in the Indian region in 2025 under the assumption of perfect correlation of interregional forecasts errors.

Sources: Authors' calculations.

---

[30] Similar adjustments occur in the case of the Chinese region. Nevertheless, the regression in the case of perfect correlation leads to a small positive value for the coefficient (0.047) associated to the regression.

5. Conclusion.

In this study, we have investigated, apparently for the first time, the impact of demographic uncertainty within a multi-regional general equilibrium, overlapping generations model. We offer four main conclusions, three empirical ones, the fourth a methodological one.

First, simulating stochastic population paths into the multi-regional world model allow us to assign probability to the different population path generated. We show that, even with an interregional correlation of 0.2 (the case we considered with the largest prediction interval), the UN high and low variants are outside from the prediction interval, illustrating that the probability they could occurred is very low.

Second, introducing stochastic population paths into the multi-regional world model indicates that the effect of the uncertainty of demography has major impact on GDP growth, the larger the uncertainty in demographics, the larger the uncertainty in GDP growth. In particular, on must note that GDP growth could be negative in the Russian world in 2050 in relation with the demographic uncertainty in this region.

Third, as one would expect, introducing stochastic demographics does not change the declining trend of the world interest rate during 2000-2050 that we get in the baseline scenario. However, a surprising finding was the narrow range of uncertainty in the interest rate, even up to 2050. Comparable interest rates, such as the bond yield rates of major companies display much more volatility. The major reason for the difference is linked to the perfect foresight hypothesis which is one of the major features of our model.

Fourth, interregional correlations of population evolution appear to be important in the multi-regional model, as they have a large impact on the uncertainty surrounding the macroeconomic variables. Although existing estimates of cross-regional correlation point to relatively low values, by considering the extreme assumption of perfect correlation we discovered a qualitatively different economic evolution, as compared to the case of

independence. Thus, the consideration of stochastic paths revealed a structural feature of the multi-regional INGENUE 2 (specifically, the link between the current account position and the level of saving in different regions) that would have been difficult to detect based on the conventional approach of considering a limited number of alternative scenarios.

References

Alders M., N.Keilman and H.Cruijsen (2006) "Assumptions for long-term stochastic population forecasts in 18 European countries", *European Journal of Population*, forthcoming.

Alho, J.M. (1997). 'Scenarios, uncertainty and conditional forecasts of the world population'. *Journal of the Royal Statistical Society. Series A* 160, 71-85.

Alho, J.M. (1998). A stochastic forecast of the population of Finland, Reviews 1998/4. Helsinki: Statistics Finland.

Alho, J.M., Cruijsen, H. and Keilman, N. (2007). 'Empirically-based specification of forecast uncertainty' in J.Alho, , S.Hougaard Jensen, & J.Lassila, editors, « *Uncertain Demographics and Fiscal Sustainability* », Cambridge University Press, forthcoming.

Alho, J.M. and Spencer, B.D. (2005). *Statistical demography and forecasting*. New York: Springer.

Auerbach, A. & Kotlikoff, L. (1987). *Dynamic Fiscal Policy*, London: Cambridge University Press.

Backus, D., Kehoe, P., and Kydland, F. (1995). 'International business cycles: theory and evidence', in Cooley ed., *Frontiers of business cycle research*, Princeton Univ. Press

Börsch-Supan, A., Ludwig, A., and Winter, J. (2006). 'Ageing, pension reform and capital flows: a multi-country simulation model'. *Economica* 73, Pp. 625-658.

Heston, A., Summers, R. & Aten, B. (2002). Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP).

IMF (2004). 'How will demographic change affect the global economy ?, World Economic Outlook.

Ingenue (2002). 'A Long Term Model for the World Economy', *in* J.O.Hairault and H.Kempf, editors, "*Market Imperfections and Macroeconomic Dynamics*" Boston: Kluwer Academic Publishers pp. 51-73.

Ingenue (2007). 'INGENUE 2: A long term intertemporal world model for the 21st century'. *CEPII Working paper*, forthcoming.

Keilman, N., Cruijsen, H. and Alho, J. (2007). "*Changing Views of Future Demographic Trends*" in J.Alho, , S.Hougaard Jensen, & J.Lassila, editors, « *Uncertain Demographics and Fiscal Sustainability* », Cambridge University Press, forthcoming.

Modigliani F. (1986). Life cycle, individual thrift, and the wealth of nations, Nobel lecture, *American Economic Review*, 76, Pp. 297-313.

National Research Council (2000). *Beyond Six Billion: Forecasting the world's population*. Panel on Population Projections. Washington DC : National Academy Press.

United Nations (2001). *World Population Prospects*. The 2000 Revision: volume I: Comprehensive Tables. New York: United Nations.

Appendix: the regions in the INGENUE 2 world model.

In the INGENUE 2 model, the World is divided in 10 regions according mainly togeographical and demographic criteria. These regions are labelled : Western Europe, Eastern Europe, North America, Latin America, Japan, Mediterranean World, Chinese World, Africa, Russian World and Indian World. The content of each region is detailed below.

"Western Europe": 'Channel Islands', 'Denmark', 'Finland', 'Iceland', 'Ireland', 'Norway', 'Sweden', 'United Kingdom', 'Greece', 'Italy', 'Malta', 'Portugal', 'Spain', 'Austria', 'Belgium', 'France', 'Germany' (East and West), 'Luxembourg', 'Netherlands', 'Switzerland'.

"Eastern Europe": 'Estonia', 'Latvia', Lithuania', 'Bulgaria', 'Czech Republic', 'Hungary', 'Poland', 'Romania', 'Slovakia', 'Slovenia', 'Albania', 'Bosnia and Herzegovina', 'Croatia', 'TFYR Macedonia', 'Yugoslavia'.

"North America": 'Canada', 'United States of America', 'Australia', 'New Zealand', 'Melanesia', 'Fiji', 'New Caledonia', 'Papua New Guinea', Solomon Islands', 'Vanuatu', 'Micronesia', 'Guam', 'Polynesia', 'French Polynesia', 'Samoa'.

"Latin America": 'Argentina', 'Bolivia', 'Brazil', 'Chile', 'Colombia', 'Ecuador', 'French Guiana', 'Guyana', 'Paraguay', 'Peru', 'Suriname', 'Uruguay', 'Venezuela', 'Belize', 'Costa Rica', 'El Salvador', 'Guatemala', 'Honduras', 'Mexico', 'Nicaragua', 'Panama', 'Bahamas', 'Barbados', 'Cuba', 'Dominican Republic', 'Guadeloupe', 'Haiti', 'Jamaica', 'Martinique', 'Netherlands Antilles', 'Puerto Rico', 'Saint Lucia', 'Trinidad and Tobago'.

Japan

"Mediterranean World" : 'Algeria', 'Egypt', 'Libyan Arab Jamahiriya', 'Morocco', , 'Tunisia', 'Western Sahara', 'Armenia', 'Azerbaijan', 'Bahrain', 'Cyprus', 'Georgia', 'Iraq', 'Iran', 'Israel', 'Jordan', 'Kuwait', 'Lebanon', 'Occupied Palestinian Territory', 'Oman', 'Qatar', 'Saudi Arabia', 'Syrian Arab Republic', 'Turkey', 'United Arab Emirates', 'Yemen', 'Turkmenistan', 'Uzbekistan' 'Kyrgyzstan'.

"Chinese World": 'China', 'Democratic People's Republic of Korea', 'Mongolia', 'Republic of Korea', 'Brunei Darussalam', 'Cambodia', 'East Timor', 'Lao People's Democratic Republic', 'Myanmar', 'Philippines', 'Singapore', 'Thailand', 'Vietnam'.

"Africa": 'Burundi', 'Comoros', 'Djibouti', 'Eritrea', 'Ethiopia', 'Kenya', 'Madagascar', 'Malawi', 'Mauritius', 'Mozambique', 'Reunion', 'Rwanda', 'Somalia', 'Uganda', 'Tanzania', 'Zambia', 'Zimbabwe', 'Angola', 'Cameroon', 'Central African Republic', 'Chad', 'Congo', 'Democratic Republic of the Congo', 'Equatorial Guinea', 'Gabon', 'Botswana', 'Lesotho', 'Namibia', 'South Africa', 'Swaziland', 'Benin', 'Burkina Faso', 'Cape Verde', 'Côte d'Ivoire', 'Gambia', 'Ghana', 'Guinea', 'Guinea-Bissau', 'Liberia', 'Mali', 'Mauritania', 'Niger', 'Nigeria', 'Senegal', 'Sierra Leone', 'Togo', 'Sudan'.

"Russian World": 'Belarus', 'Russian Federation', 'Ukraine', 'Republic of Moldova'.

"Indian World": 'India', 'Afghanistan', 'Bangladesh', 'Bhutan', 'Maldives', 'Nepal', 'Pakistan', 'Sri Lanka', 'Tajikistan', 'Kazakhstan', 'Indonesia', 'Malaysia'.

Notes d'Études et de Recherche

1. C. Huang and H. Pagès, "Optimal Consumption and Portfolio Policies with an Infinite Horizon: Existence and Convergence," May 1990.

2. C. Bordes, « Variabilité de la vitesse et volatilité de la croissance monétaire : le cas français », février 1989.

3. C. Bordes, M. Driscoll and A. Sauviat, "Interpreting the Money-Output Correlation: Money-Real or Real-Real?," May 1989.

4. C. Bordes, D. Goyeau et A. Sauviat, « Taux d'intérêt, marge et rentabilité bancaires : le cas des pays de l'OCDE », mai 1989.

5. B. Bensaid, S. Federbusch et R. Gary-Bobo, « Sur quelques propriétés stratégiques de l'intéressement des salariés dans l'industrie », juin 1989.

6. O. De Bandt, « L'identification des chocs monétaires et financiers en France : une étude empirique », juin 1990.

7. M. Boutillier et S. Dérangère, « Le taux de crédit accordé aux entreprises françaises : coûts opératoires des banques et prime de risque de défaut », juin 1990.

8. M. Boutillier and B. Cabrillac, "Foreign Exchange Markets: Efficiency and Hierarchy," October 1990.

9. O. De Bandt et P. Jacquinot, « Les choix de financement des entreprises en France : une modélisation économétrique », octobre 1990 (English version also available on request).

10. B. Bensaid and R. Gary-Bobo, "On Renegotiation of Profit-Sharing Contracts in Industry," July 1989 (English version of NER n° 5).

11. P. G. Garella and Y. Richelle, "Cartel Formation and the Selection of Firms," December 1990.

12. H. Pagès and H. He, "Consumption and Portfolio Decisions with Labor Income and Borrowing Constraints," August 1990.

13. P. Sicsic, « Le franc Poincaré a-t-il été délibérément sous-évalué ? », octobre 1991.

14. B. Bensaid and R. Gary-Bobo, "On the Commitment Value of Contracts under Renegotiation Constraints," January 1990 revised November 1990.

15. B. Bensaid, J.-P. Lesne, H. Pagès and J. Scheinkman, "Derivative Asset Pricing with Transaction Costs," May 1991 revised November 1991.

16. C. Monticelli and M.-O. Strauss-Kahn, "European Integration and the Demand for Broad Money," December 1991.

17. J. Henry and M. Phelipot, "The High and Low-Risk Asset Demand of French Households: A Multivariate Analysis," November 1991 revised June 1992.

18. B. Bensaid and P. Garella, "Financing Takeovers under Asymetric Information," September 1992.

19. A. de Palma and M. Uctum, "Financial Intermediation under Financial Integration and Deregulation," September 1992.

20. A. de Palma, L. Leruth and P. Régibeau, "Partial Compatibility with Network Externalities and Double Purchase," August 1992.

21. A. Frachot, D. Janci and V. Lacoste, "Factor Analysis of the Term Structure: a Probabilistic Approach," November 1992.

22. P. Sicsic et B. Villeneuve, « L'afflux d'or en France de 1928 à 1934 », janvier 1993.

23. M. Jeanblanc-Picqué and R. Avesani, "Impulse Control Method and Exchange Rate," September 1993.

24. A. Frachot and J.-P. Lesne, "Expectations Hypothesis and Stochastic Volatilities," July 1993 revised September 1993.

25. B. Bensaid and A. de Palma, "Spatial Multiproduct Oligopoly," February 1993 revised October 1994.

26. A. de Palma and R. Gary-Bobo, "Credit Contraction in a Model of the Banking Industry," October 1994.

27. P. Jacquinot et F. Mihoubi, « Dynamique et hétérogénéité de l'emploi en déséquilibre », septembre 1995.

28. G. Salmat, « Le retournement conjoncturel de 1992 et 1993 en France : une modélisation VAR », octobre 1994.

29. J. Henry and J. Weidmann, "Asymmetry in the EMS Revisited: Evidence from the Causality Analysis of Daily Eurorates," February 1994 revised October 1994.

30. O. De Bandt, "Competition Among Financial Intermediaries and the Risk of Contagious Failures," September 1994 revised January 1995.

31. B. Bensaid et A. de Palma, « Politique monétaire et concurrence bancaire », janvier 1994 révisé en septembre 1995.

32. F. Rosenwald, « Coût du crédit et montant des prêts : une interprétation en terme de canal large du crédit », septembre 1995.

33. G. Cette et S. Mahfouz, « Le partage primaire du revenu : constat descriptif sur longue période », décembre 1995.

34. H. Pagès, "Is there a Premium for Currencies Correlated with Volatility? Some Evidence from Risk Reversals," January 1996.

35. E. Jondeau and R. Ricart, "The Expectations Theory: Tests on French, German and American Euro-rates," June 1996.

36. B. Bensaid et O. De Bandt, « Les stratégies "stop-loss" : théorie et application au Contrat Notionnel du Matif », juin 1996.

37. C. Martin et F. Rosenwald, « Le marché des certificats de dépôts. Écarts de taux à l'émission : l'influence de la relation émetteurs-souscripteurs initiaux », avril 1996.

38.   Banque de France - CEPREMAP - Direction de la Prévision - Erasme - INSEE - OFCE, « Structures et propriétés de cinq modèles macroéconomiques français », juin 1996.

39.   F. Rosenwald, « L'influence des montants émis sur le taux des certificats de dépôts », octobre 1996.

40.   L. Baumel, « Les crédits mis en place par les banques AFB de 1978 à 1992 : une évaluation des montants et des durées initiales », novembre 1996.

41.   G. Cette et E. Kremp, « Le passage à une assiette valeur ajoutée pour les cotisations sociales : Une caractérisation des entreprises non financières "gagnantes" et "perdantes" », novembre 1996.

42.   S. Avouyi-Dovi, E. Jondeau et C. Lai Tong, « Effets "volume", volatilité et transmissions internationales sur les marchés boursiers dans le G5 », avril 1997.

43.   E. Jondeau et R. Ricart, « Le contenu en information de la pente des taux : Application au cas des titres publics français », juin 1997.

44.   B. Bensaid et M. Boutillier, « Le contrat notionnel : efficience et efficacité », juillet 1997.

45.   E. Jondeau et R. Ricart, « La théorie des anticipations de la structure par terme : test à partir des titres publics français », septembre 1997.

46.   E. Jondeau, « Représentation VAR et test de la théorie des anticipations de la structure par terme », septembre 1997.

47.   E. Jondeau et M. Rockinger, « Estimation et interprétation des densités neutres au risque : Une comparaison de méthodes », octobre 1997.

48.   L. Baumel et P. Sevestre, « La relation entre le taux de crédits et le coût des ressources bancaires. Modélisation et estimation sur données individuelles de banques », octobre 1997.

49.   P. Sevestre, "On the Use of Banks Balance Sheet Data in Loan Market Studies : A Note," October 1997.

50.   P.-C. Hautcoeur and P. Sicsic, "Threat of a Capital Levy, Expected Devaluation and Interest Rates in France during the Interwar Period," January 1998.

51.   P. Jacquinot, « L'inflation sous-jacente à partir d'une approche structurelle des VAR : une application à la France, à l'Allemagne et au Royaume-Uni », janvier 1998.

52.   C. Bruneau et O. De Bandt, « La modélisation VAR structurel : application à la politique monétaire en France », janvier 1998.

53.   C. Bruneau and E. Jondeau, "Long-Run Causality, with an Application to International Links between Long-Term Interest Rates," June 1998.

54.   S. Coutant, E. Jondeau and M. Rockinger, "Reading Interest Rate and Bond Futures Options' Smiles: How PIBOR and Notional Operators Appreciated the 1997 French Snap Election," June 1998.

55.   E. Jondeau et F. Sédillot, « La prévision des taux longs français et allemands à partir d'un modèle à anticipations rationnelles », juin 1998.

56.   E. Jondeau and M. Rockinger, "Estimating Gram-Charlier Expansions with Positivity Constraints," January 1999.

57.   S. Avouyi-Dovi and E. Jondeau, "Interest Rate Transmission and Volatility Transmission along the Yield Curve," January 1999.

58.   S. Avouyi-Dovi et E. Jondeau, « La modélisation de la volatilité des bourses asiatiques », janvier 1999.

59.   E. Jondeau, « La mesure du ratio rendement-risque à partir du marché des euro-devises », janvier 1999.

60.   C. Bruneau and O. De Bandt, "Fiscal Policy in the Transition to Monetary Union: A Structural VAR Model," January 1999.

61.   E. Jondeau and R. Ricart, "The Information Content of the French and German Government Bond Yield Curves: Why Such Differences?," February 1999.

62.   J.-B. Chatelain et P. Sevestre, « Coûts et bénéfices du passage d'une faible inflation à la stabilité des prix », février 1999.

63.   D. Irac et P. Jacquinot, « L'investissement en France depuis le début des années 1980 », avril 1999.

64.   F. Mihoubi, « Le partage de la valeur ajoutée en France et en Allemagne », mars 1999.

65.   S. Avouyi-Dovi and E. Jondeau, "Modelling the French Swap Spread," April 1999.

66.   E. Jondeau and M. Rockinger, "The Tail Behavior of Stock Returns: Emerging Versus Mature Markets," June 1999.

67.   F. Sédillot, « La pente des taux contient-elle de l'information sur l'activité économique future ? », juin 1999.

68.   E. Jondeau, H. Le Bihan et F. Sédillot, « Modélisation et prévision des indices de prix sectoriels », septembre 1999.

69.   H. Le Bihan and F. Sédillot, "Implementing and Interpreting Indicators of Core Inflation: The French Case," September 1999.

70.   R. Lacroix, "Testing for Zeros in the Spectrum of an Univariate Stationary Process: Part I," December 1999.

71.   R. Lacroix, "Testing for Zeros in the Spectrum of an Univariate Stationary Process: Part II," December 1999.

72.   R. Lacroix, "Testing the Null Hypothesis of Stationarity in Fractionally Integrated Models," December 1999.

73.   F. Chesnay and E. Jondeau, "Does correlation between stock returns really increase during turbulent period?," April 2000.

74.   O. Burkart and V. Coudert, "Leading Indicators of Currency Crises in Emerging Economies," May 2000.

75.   D. Irac, "Estimation of a Time Varying NAIRU for France," July 2000.

76. E. Jondeau and H. Le Bihan, "Evaluating Monetary Policy Rules in Estimated Forward-Looking Models: A Comparison of US and German Monetary Policies," October 2000.

77. E. Jondeau and M. Rockinger, "Conditional Volatility, Skewness, ans Kurtosis: Existence and Persistence," November 2000.

78. P. Jacquinot et F. Mihoubi, « Modèle à Anticipations Rationnelles de la COnjoncture Simulée : MARCOS », novembre 2000.

79. M. Rockinger and E. Jondeau, "Entropy Densities: With an Application to Autoregressive Conditional Skewness and Kurtosis," January 2001.

80. B. Amable and J.-B. Chatelain, "Can Financial Infrastructures Foster Economic Development? ," January 2001.

81. J.-B. Chatelain and J.-C. Teurlai, "Pitfalls in Investment Euler Equations," January 2001.

82. M. Rockinger and E. Jondeau, "Conditional Dependency of Financial Series: An Application of Copulas," February 2001.

83. C. Florens, E. Jondeau and H. Le Bihan, "Assessing GMM Estimates of the Federal Reserve Reaction Function," March 2001.

84. J.-B. Chatelain, "Mark-up and Capital Structure of the Firm facing Uncertainty," June 2001.

85. B. Amable, J.-B. Chatelain and O. De Bandt, "Optimal Capacity in the Banking Sector and Economic Growth," June 2001.

86. E. Jondeau and H. Le Bihan, "Testing for a Forward-Looking Phillips Curve. Additional Evidence from European and US Data," December 2001.

87. G. Cette, J. Mairesse et Y. Kocoglu, « Croissance économique et diffusion des TIC : le cas de la France sur longue période (1980-2000) », décembre 2001.

88. D. Irac and F. Sédillot, "Short Run Assessment of French Economic Activity Using OPTIM," January 2002.

89. M. Baghli, C. Bouthevillain, O. de Bandt, H. Fraisse, H. Le Bihan et Ph. Rousseaux, « PIB potentiel et écart de PIB : quelques évaluations pour la France », juillet 2002.

90. E. Jondeau and M. Rockinger, "Asset Allocation in Transition Economies," October 2002.

91. H. Pagès and J.A.C. Santos, "Optimal Supervisory Policies and Depositor-Preferences Laws," October 2002.

92. C. Loupias, F. Savignac and P. Sevestre, "Is There a Bank Lending Channel in France? Evidence from Bank Panel Data," November 2002.

93. M. Ehrmann, L. Gambacorta, J. Martínez-Pagés, P. Sevestre and A. Worms, "Financial Systems and The Role in Monetary Policy Transmission in the Euro Area," November 2002.

94. S. Avouyi-Dovi, D. Guégan et S. Ladoucette, « Une mesure de la persistance dans les indices boursiers », décembre 2002.

95. S. Avouyi-Dovi, D. Guégan et S. Ladoucette, "What is the Best Approach to Measure the Interdependence between Different Markets? ," December 2002.

96. J.-B. Chatelain and A. Tiomo, "Investment, the Cost of Capital and Monetary Policy in the Nineties in France: A Panel Data Investigation," December 2002.

97. J.-B. Chatelain, A. Generale, I. Hernando, U. von Kalckreuth and P. Vermeulen, "Firm Investment and Monetary Policy Transmission in the Euro Area," December 2002.

98. J.-S. Mésonnier, « Banque centrale, taux de l'escompte et politique monétaire chez Henry Thornton (1760-1815) », décembre 2002.

99. M. Baghli, G. Cette et A. Sylvain, « Les déterminants du taux de marge en France et quelques autres grands pays industrialisés : Analyse empirique sur la période 1970-2000 », janvier 2003.

100. G. Cette and Ch. Pfister, "The Challenges of the "New Economy" for Monetary Policy," January 2003.

101. C. Bruneau, O. De Bandt, A. Flageollet and E. Michaux, "Forecasting Inflation using Economic Indicators: the Case of France," May 2003.

102. C. Bruneau, O. De Bandt and A. Flageollet, "Forecasting Inflation in the Euro Area," May 2003.

103. E. Jondeau and H. Le Bihan, "ML vs GMM Estimates of Hybrid Macroeconomic Models (With an Application to the "New Phillips Curve")," September 2003.

104. J. Matheron and T.-P. Maury, "Evaluating the Fit of Sticky Price Models," January 2004.

105. S. Moyen and J.-G. Sahuc, "Incorporating Labour Market Frictions into an Optimising-Based Monetary Policy Model," January 2004.

106. M. Baghli, V. Brunhes-Lesage, O. De Bandt, H. Fraisse et J.-P. Villetelle, « MASCOTTE : Modèle d'Analyse et de préviSion de la COnjoncture TrimesTriellE », février 2004.

107. E. Jondeau and M. Rockinger, "The Bank Bias: Segmentation of French Fund Families," February 2004.

108. E. Jondeau and M. Rockinger, "Optimal Portfolio Allocation Under Higher Moments," February 2004.

109. C. Bordes et L. Clerc, « Stabilité des prix et stratégie de politique monétaire unique », mars 2004.

110. N. Belorgey, R. Lecat et T.-P. Maury, « Déterminants de la productivité par employé : une évaluation empirique en données de panel », avril 2004.

111. T.-P. Maury and B. Pluyaud, "The Breaks in per Capita Productivity Trends in a Number of Industrial Countries," April 2004.

112. G. Cette, J. Mairesse and Y. Kocoglu, "ICT Diffusion and Potential Output Growth," April 2004.

113. L. Baudry, H. Le Bihan, P. Sevestre and S. Tarrieu, "Price Rigidity. Evidence from the French CPI Micro-Data," September 2004.

114. C. Bruneau, O. De Bandt and A. Flageollet, "Inflation and the Markup in the Euro Area," September 2004.

115. J.-S. Mésonnier and J.-P. Renne, "A Time-Varying "Natural" Rate of Interest for the Euro Area," September 2004.

116. G. Cette, J. Lopez and P.-S. Noual, "Investment in Information and Communication Technologies: an Empirical Analysis," October 2004.

117. J.-S. Mésonnier et J.-P. Renne, « Règle de Taylor et politique monétaire dans la zone euro », octobre 2004.

118. J.-G. Sahuc, "Partial Indexation, Trend Inflation, and the Hybrid Phillips Curve," December 2004.

119. C. Loupias et B. Wigniolle, « Régime de retraite et chute de la natalité : évolution des mœurs ou arbitrage micro-économique ? », décembre 2004.

120. C. Loupias and R. Ricart, "Price Setting in France: new Evidence from Survey Data," December 2004.

121. S. Avouyi-Dovi and J. Matheron, "Interactions between Business Cycles, Stock Markets Cycles and Interest Rates: the Stylised Facts," January 2005.

122. L. Bilke, "Break in the Mean and Persistence of Inflation: a Sectoral Analysis of French CPI," January 2005.

123. S. Avouyi-Dovi and J. Matheron, "Technology Shocks and Monetary Policy in an Estimated Sticky Price Model of the US Economy," April 2005.

124. M. Dupaigne, P. Fève and J. Matheron, "Technology Shock and Employement: Do We Really Need DSGE Models with a Fall in Hours?," June 2005.

125. P. Fève and J. Matheron, "Can the Kydland-Prescott Model Pass the Cogley-Nason Test?," June 2005.

126. S. Avouyi-Dovi and J. Matheron, "Technology Shocks and Monetary Policy in an Estimated Sticky Price Model of the Euro Area," June 2005.

127. O. Loisel, "Central Bank Reputation in a Forward-Looking Model," June 2005.

128. B. Bellone, E. Gautier et S. Le Coent, « Les marchés financiers anticipent-ils les retournements conjoncturels ? », juillet 2005.

129. P. Fève, « La modélisation macro-économétrique dynamique », juillet 2005.

130. G. Cette, N. Dromel and D. Méda, "Opportunity Costs of Having a Child, Financial Constraints and Fertility," August 2005.

131. S. Gouteron et D. Szpiro, « Excès de liquidité monétaire et prix des actifs », septembre 2005.

132. J. Baude, « L'impact des chocs boursiers sur le crédit en France depuis le milieu des années quatre-vingt-dix », septembre 2005.

133. R. Bourlès and G. Cette, "A Comparison of Structural Productivity Levels in the Major Industrialised Countries," October 2005.

134. T. Grunspan, "The Fed and the Question of Financial Stability: An Empirical Investigation," October 2005.

135. S. Fabiani, M. Druant, I. Hernando, C. Kwapil, B. Landau, C. Loupias, F. Martins, T. Mathä, R. Sabbatini, H. Stahl and A. Stockman, "The Pricing Behaviour of Firms in the Euro Area: New Survey Evidence," November 2005.

136. E. Dhyne, L. Alvarez, H. Le Bihan, G. Veronese, D. Dias, J. Hoffmann, N. Jonker, P. Lünnemann, F. Rumler and J. Vilmunen, "Price Setting in the Euro Area: Some Stylized Facts from Individual Consumer Price Data," November 2005.

137. D. Fougère, H. Le Bihan and P. Sevestre, "Heterogeneity in Consumer Price Stickiness: A Microeconometric Investigation," November 2005.

138. L. Alvarez, E. Dhyne, M. Hoeberichts, C. Kwapil, H. Le Bihan, P. Lünnemann, F. Martins, R. Sabbatini, H. Stahl, P. Vermeulen and J. Vilmunen, "Sticky Prices in the Euro Area: a Summary of New Micro Evidence," November 2005.

139. E. Kharroubi, "Illiquidity, Financial Development and the Growth-Volatility Relationship," February 2006.

140. M. Baghli, C. Cahn and H. Fraisse, "Is the Inflation-Output Nexus Asymmetric in the Euro Area," April 2006.

141. E. Jondeau and J-G. Sahuc, "Optimal Monetary Policy in an Estimated DSGE Model of the Euro Area with Cross-country Heterogeneity," April 2006.

142. S. Avouyi-Dovi, M. Brun, A. Dreyfus, F. Drumetz, V. Oung et J.-G. Sahuc, « La fonction de demande de monnaie pour la zone euro : un réexamen », mai 2006.

143. C. Jardet, "Term Structure Anomalies : Term Premium or Peso Problem?" May 2006.

144. S. Avouyi-Dovi, R. Kierzenkowski and C. Lubochinsky, "Are Business and Credit Cycles Converging or Diverging? A comparison of Poland, Hungary, the Czech Republic and the Euro Area", May 2006.

145. O. De Bandt, C. Bruneau and A. Flageollet, "Assessing Aggregate Comovements in France, Germany and Italy. Using a Non Stationary Factor Model of the Euro Area" June 2006.

146. M. Baghli, C. Cahn and J-P. Villetelle, "Estimating Potential Output with a Production Function for France, Germany and Italy", June 2006.

147. E. Fonteny, « La désaisonnalisation des séries d'agrégats monétaires et de crédit à la Banque de France : aspects théoriques et mise en œuvre », juin 2006.

148. J. Matheron and C. Poilly, "How Well Does a Small Structural Model with Sticky Prices and Wages Fit Postwar U.S. Data", July 2006.

149. E. Kharroubi, "Financial (Dis) Integration," July 2006.

150. J. Carrillo, P. Fève and J. Matheron, "Monetary Policy Inertia or Persistent Shocks?" July 2006.

151. C. Ewerhart, N. Cassola and N. Valla, "Declining Valuations and Equilibrium Bidding in Central Bank Refinancing Operations," August 2006.

152. D. Fougère, « Réformes structurelles sur le marché du travail : quels enseignements peut-on tirer des études existantes », août 2006.

153. D. Irac, "Revisiting the proximity-concentration trade-off: Distance and Horizontal Foreign Direct Investment in OECD Countries," August 2006.

154. D. Irac and C. Minoiu, "Risk insurance in a Transition Economy: Evidence from Rural Romania," August 2006.

155. H. Lustig and A. Verdelhan, "The Cross-Section of Foreign Currency Risk Premia and Consumption Growth Risk," August 2006.

156. R. Bourlès and G. Cette, "Trends in "structural" productivity levels in the major industrialized countries," September 2006.

157. J.-S. Mésonnier, "The Reliability of Macroeconomic Forecasts based on Real Interest Rate Gap Estimates in Real Time: an Assessment for the Euro Area," October 2006.

158. O. de Bandt, C. Bruneau and W. El Amri, "Convergence in Household Credit Demand across Euro Area Countries: Evidence from Panel Data," October 2006.

159. J. Idier, "Stock Exchanges Industry Consolidation and Shock Transmission," December 2006.

160. E. Gautier, "The Behaviour of Producer Prices: Some Evidence from the French PPI Micro Data," December 2006.

161. O. Loisel, "Bubble-free interest-rate rules," December 2006.

162. J. Boivin and M. P. Giannoni, "DSGE Models in a Data-Rich Environment," January 2007.

163. J. Coffinet, J. Matheron et C. Poilly, « Une évaluation structurelle du ratio de sacrifice dans la zone euro », janvier 2007.

164. P. Vermeulen, D. Dias, M. Dossche, E. Gautier, I. Hernando, R. Sabbatini and H. Stahl, "Price setting in the euro area: Some stylised facts from Individual Producer Price Data," February 2007.

165. C. Bordes, L. Clerc and V. Marimoutou, "Is there a structural break in equilibrium velocity in the euro area?" February 2007.

166. D. Fougère, « Les méthodes micro-économétriques d'évaluation », mars 2007.

167. C. Jardet and G. Le Fol, "Euro money market interest rates dynamics and volatility: How they respond to recent changes in the operational framework," May 2007.

168. L. Clerc, "Understanding asset prices: determinants and policy implications," May 2007.

169. F. Savignac, "The impact of financial constraints on innovation: What can be learned from a direct measure?," June 2007.

170. J. Idier, C. Jardet and A. de Loubens, "Determinants of long-term interest rates in the United States and the euro area: A multivariate approach," June 2007.

171. O. Darné et V. Brunhes-Lesage, « L'Indicateur Synthétique Mensuel d'Activité (ISMA) : une révision », Juillet 2007.

172. R. Kierzenkowski et V. Oung, « L'évolution des crédits à l'habitat en France : une grille d'analyse en termes de cycles », Juillet 2007.

173. O. de Bandt, A. Banerjee and T. Koźluk, "Measuring Long-Run Exchange Rate Pass-Through," July 2007.

174. J. Alho and V. Borgy, "Global Ageing and Macroeconomic Consequences of Demographic Uncertainty in a Multi-regional Model," July 2007.