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Economic impact of migration flows following the 2004 EU enlargement process – A model based analysis -

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Abstract:
This paper shows that the migration-induced re-allocation of labour resources across countries following the 2004 EU enlargement process has already brought sizeable economic benefits for the enlarged EU. In addition, the simulation results suggest that once the present temporary restrictions on the flow of EU10 workers come to an end and the long-run migration potential of around 3 million is eventually realised, the economic gains may easily match those from a further integration of the EU's goods and capital markets. At the level of the individual "sending" and "receiving" countries, the overall economic impact of migration is essentially determined by the speed of adjustment of labour and capital; by the skill characteristics of the migrant and native populations; and by the actual size of the migration flows. Whilst the results at the total economy level suggest that the individual EU10 and EU15 countries can all gain from facilitating migration, at the level of specific skill groups there is the potential for income losses for the low skilled in the "receiving" countries and for medium to high skilled workers in the "sending" countries.

Keywords: growth, migration, European Union

JEL Classification: D24, F22, O41, O52

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1. Introduction

One of the big unknowns for policy makers surrounding the May 2004 EU enlargement process was the effect it would have on East-West migration flows, both in terms of the actual numbers moving across borders as well as the economic impact of those flows on the sending (EU10) and receiving (EU15) Member States. At the time of enlargement, and indeed in subsequent years, this migration question was the focus of a significant body of economic research since the free movement of workers constituted the principal change in economic integration after accession, as barriers to trade, FDI and other capital movements had already been largely removed in the run up to enlargement.

Many commentators feared that large and dislocating movements of EU10 workers into EU15 labour markets were inevitable given the sizeable income differentials which existed in the pre-enlargement period. These fears led to many EU15 countries imposing temporary restrictions on the flow of EU10 workers into their countries, with just three Member States (i.e. the UK, Ireland and Sweden) fully opening their labour markets in May 2004.

In standard migration models, migration is predicted to yield gains, at the aggregate level, due to a more efficient allocation of labour resources and by facilitating the matching of workers' skills with the available job vacancies in an expanded labour market[1]. However, according to the literature, these benefits may not be evenly distributed between the receiving and sending countries nor between different groups of citizens within the individual economies:

- In the receiving countries, immigration would be expected to initially increase the labour supply without a corresponding rise in the capital stock. The level of GDP would increase, whilst the impact on employment and wages would be affected by the specific features of the individual labour markets. If labour markets are flexible, immigration is normally predicted to lead in the short run to lower wages and higher returns on capital, benefiting capital owners and reducing the welfare of those supplying labour inputs[2]. In addition, the moderation in wages should help in reducing inflationary pressures. In the presence of labour market rigidities, however, the increase in the labour force can lead to a temporary increase in the unemployment rate. Moreover, the overall effect of migration on wages and employment depends on the skill composition of the migrants[3] and their degree of complementarity / substitutability with native workers[4]. For example, if the migrants fill bottlenecks in the domestic labour market, immigration is usually associated with an increase in employment in the host economy.

[1] Labour market imperfections, such as poor information flows, often lead to situations where job vacancies exist simultaneously with the availability of unemployed workers, with these essentially frictional forms of unemployment potentially being more serious when skill mismatches arise across countries. In these latter circumstances, migration can help in ensuring that labour markets adjust by generating a better match between the supply and demand for various types of skills. In addition, better skill matches, due to this enhanced geographical mobility, increases the returns to human capital which in turn increases incentives to invest in education.

[2] For a discussion, see Riley and Weale (2006).

[3] See Borjas (1999).

[4] As pointed out in Brücker (2007) "production factors in receiving countries that are net complements to migrant labor tend to win, while those which are net substitutes tend to lose. More specifically, labor is expected to lose at the destination. The converse applies to the sending countries."

- In the sending countries, migration tends to provoke a short run increase in the capital/labour ratio, which translates into higher wages, higher inflationary pressures and lower returns on capital. Productivity would be expected to increase as the flow of capital becomes more abundant. In the long run, however, the capital stock is likely to decrease in the sending countries, causing the capital/labour ratio to return to equilibrium. In overall terms, the availability of "surplus" labour in the sending countries should ensure that the latter gain from declines in unemployment and from an influx of emigrants' remittances[5], with the migrants themselves benefitting strongly either as a result of moving out of unemployment or from finding a better remunerated job[6].

Against this backdrop, the present paper examines the reality regarding EU10 / EU15 migration flows over recent years and assesses whether the initial economic predictions, including those of standard migration models, have been confirmed or confounded by actual events. Whilst statistics on East-West migration flows continue to display quality problems[7] and bearing in mind the often illegal nature of at least some of the post-2004 flows, the present paper uses the Quest model[8] to provide a tentative, quantitative, assessment of the economic implications of the officially recorded flows on the economies of the EU15, EU10 and EU25 country groupings as well as on their constituent Member States (see Annex 1).

The remainder of the paper is organised as follows. Section 2 presents the basic data on migration flows as well as providing some information regarding the skill profile of migrants compared with local workers. Section 3, on the basis of a number of Quest simulations, gives an assessment of the economic implications of the post-2004 migration flows for both the receiving and sending countries. Section 4 compares the Quest simulation results with those from a number of other studies in the literature, with the final section providing a short summary of the paper as well as highlighting the main conclusions to be drawn from the analysis.

2. Internal EU migration flows following the 2004 enlargement: An overview of the actual numbers involved as well as a comparison of skill levels

2.1: Post 2004 EU migration flows: Number of migrants and their geographical focus: Annex 2 provides an analysis of the demographic impact which the May 2004 enlargement had with respect to EU migration flows, with the key numbers being summarised overleaf in graph

[5] According to the World Bank (2008), remittances in 2006 amounted to roughly 1 ¼% of GDP in Poland and to over 2% of GDP in each of the 3 Baltic states.

[6] According to Brücker (2007), the main winners from migration are the migrants themselves, with average income gains of more than 100 percent.

[7] As an illustration of the degree of uncertainty attached to migration estimates, Iakova (2005) in an assessment of the economic effects of migration from the new EU member states (excluding Cyprus and Malta i.e. EU8) into the UK had to choose between the following four sets of conflicting estimates of the migration flows: 1. Worker Registration Scheme (WRS) – estimate of 510,000 (May 2004-September 2006); 2. International Passenger Survey (IPS) – estimate of 113,000 (2004-2005); 3. Labour Force Survey (LFS) - estimate of 265,000 (May 2004-September 2006); 4. National Insurance (NI) – estimate of 380,000 (April 2004 – March 2006).

[8] The QUEST model is a micro-founded, dynamic stochastic general equilibrium model which incorporates nominal, real and financial frictions (see Ratto, Röeger and in't Veld, 2008, and Röeger, Varga and in't Veld, 2008); a brief description of the model is provided in Annex 3.

1 and table 1. From the perspective of the Quest simulations to be carried out in section 3, a number of important conclusions can be drawn from this material, including the following:

- Firstly, whilst the overall level of migration has been broadly equivalent to the predictions included in ECFIN's 2001 assessment of the migration potential of the new Member States[9], what has been different has been the geographical focus of the flows. Back in 2001 it was predicted that Germany and Austria were likely to be the main recipients of the higher EU10 migration movements. However, these predictions were based on the assumption that all of the EU15 member states would allow unrestricted access to their labour markets once the EU10 countries had become formal members of the Union. As can be seen in Table 1, the temporary labour market restrictions put in place by all of the EU15 countries except the UK, Ireland and Sweden resulted in a major diversion of the EU10 migration flows to these latter countries, especially the UK and Ireland.

- Secondly, from the perspective of the receiving countries, whilst EU10 migration was quantitatively much less significant than inflows from non-EU25 countries for 2004-2007 (see annex 2), nevertheless it represented a cumulative increase in the EU15's working age population of 0.37% over the period as a whole, equivalent to an annual average increase of slightly less than 0.1% (graph 1a). Whilst the EU15 average effect was quiet subdued, the effects on individual EU15 countries such as the UK and Ireland were much more substantial, with for example Ireland experiencing an average annual increase of 1 ¼ % in its working age population over the 2004-2007 period due to the inflow of EU10 migrants.

- Finally, from the perspective of the sending countries, the outflows (as a share of their working age populations) were substantially higher compared with the equivalent EU15 effects. Over the period 2004-2007, around 1 million people left the EU10 member states which was equivalent to 2% of the EU10's working age population, an annual average haemorrhage of potential workers of ½% a year. As with the receiving countries, the specific impact on individual EU10 countries was very varied, ranging from virtually no outflows from countries such as Slovenia, to cumulative outflows of close to 4% and over 5% of the working age populations of countries such as Latvia and Lithuania respectively (i.e. an annual average impact of 1% and 1 ¼% respectively – see graph 1b).

[9] "The economic impact of enlargement", Directorate General for Economic and Financial Affairs (ECFIN), Enlargement Papers No. 4, June 2001. Broadly equivalent, pre-accession, studies include Alvarez-Plati et al. (2003), Krieger (2003) and Bauer / Zimmermann (1999). All of these studies predicted short-run annual inflows of EU10 migrants of between 300 – 400 thousand into the EU15 Member States.

Table 1: Changes in EU Migration Flows following the 2004 Enlargement

Immigration Impact on Receiving (EU15) Member States				Emigration Impact on Sending (EU10) Member States			
Countries	**Change in number of EU10 citizens resident in individual EU15 countries (2004-2007)**			**Countries**	**Change in number of EU10 citizens emigrating to EU15 countries (2004-2007)**		
	000's	**% of Working Age Population of individual EU15 countries***	**Annual Average Impact on Working Age Population (%)**		**000's**	**% of Working Age Population of individual EU10 countries***	**Annual Average Impact on Working Age Population (%)**
Belgium	20	0.29	0.07	**Czech Republic**	44	0.60	0.15
Denmark	3	0.08	0.02	**Estonia**	14	1.49	0.37
Germany	96	0.18	0.04	**Cyprus**	No change***		
Ireland	162	5.56	1.39	**Latvia**	62	3.95	0.99
Greece	7	0.09	0.02	**Lithuania**	121	5.22	1.30
Spain	67	0.22	0.06	**Hungary**	31	0.44	0.11
France	5	0.01	0.00	**Malta**	No change***		
Italy	32	0.08	0.02	**Poland**	627	2.32	0.58
Luxembourg	na	Na	na	**Slovenia**	1	0.08	0.02
Netherlands	17	0.15	0.04	**Slovakia**	92	2.36	0.59
Austria	26	0.46	0.12	**Total (EU10)**	**991****	**1.93**	**0.48**
Portugal	na	Na	na				
Finland	6	0.17	0.04				
Sweden	12	0.20	0.05				
UK	532	1.32	0.33				
Total (EU15)	**991****	**0.37**	**0.10**				

* **Share of working age population in 2007 minus the share in 2004.**

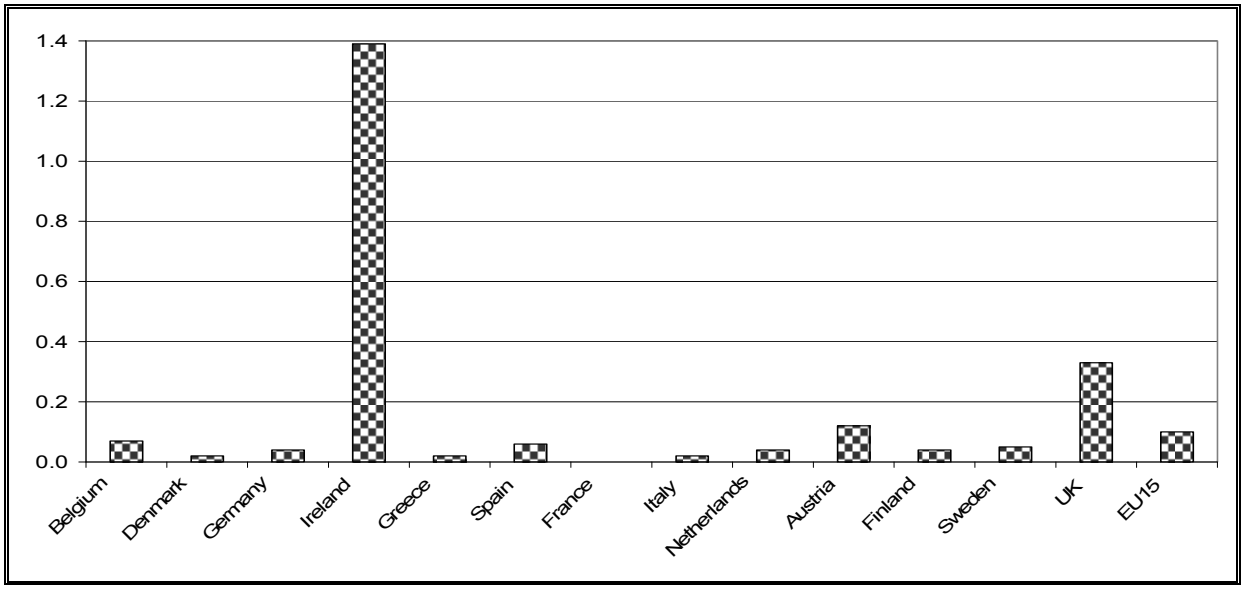
** **This total includes estimates for Luxembourg and Portugal. The total for the remaining 13 countries is 985,000.**

*** **An assumption of no change in the flow of migrants from Cyprus and Malta is plausible since, unlike the other new Member States, citizens of these countries were allowed to work in a number of EU Member States, including the UK, prior to 2004.**

**** **Given the higher quality of the immigration statistics, it is assumed that EU10 emigration to EU15 countries is identical to immigration of EU10 citizens into EU15 countries.**

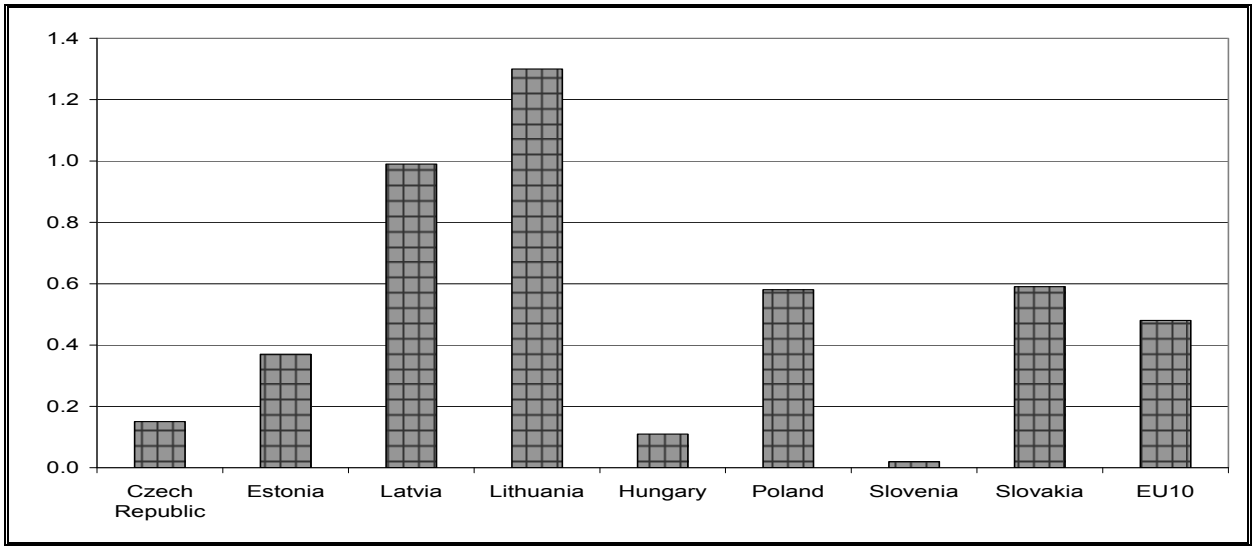
Source: EU15 countries - Eurostat's EU Labour Force Survey, Eurostat Population Statistics, National data sources, Commission services
EU10 countries - IMF

Graph 1a: Annual average impact on the growth of the working age population of "receiving" countries - % (2004-2007)
Selected EU15 countries



Source: Same as table 1

Graph 1b: Annual average impact on the decline in the working age population of "sending" countries - % (2004-2007)
Selected EU10 countries



Source: Same as table 1

2.2. Skill levels of migrants compared with "local" workers: With respect to the available information concerning the skill levels of migrants, a number of studies have compared the education levels of migrants with those of comparable workers in the EU15 host countries. For example, Munz et al. (2004) showed that the skill levels of migrants from central and eastern European countries were not dramatically different from the averages pertaining in the EU15 as a whole. Dustman et al. (2005) arrive at a broadly similar conclusion for the skill distribution of immigrants and "local" workers in the UK. However, whilst this may have been the case in the pre-accession period (the period used by both Munz et al. and Dustman et

al.), the evidence in relation to the post-accession period would suggest that this is somewhat inconsistent with the skill content of the jobs being carried out by many EU10 migrants. Recent EU10 migrants in fact have tended to be much more heavily concentrated in low skilled jobs compared with the "domestic" population. For example, evidence for the UK presented by the NIESR[10] to the House of Lords Select Committee on Economic Affairs (2007), compared the labour market characteristics of EU10 workers who came to the UK over the period 2004-2006 with all migrants who came to the UK over the period 1998-2003 (see Table 2). They found that recent EU10 migrants were heavily concentrated in low skilled jobs (63%)[11] compared with all migrants to the UK in the earlier 1998-2003 period (22%). This low skilled figure of 63% for migrants compares with a figure of less than 20% for the UK population as a whole. These results show that there may be substantial differences in the skill content of the jobs taken by recent EU10 migrants compared with those of the local working population and that these differences between migrants and host country workers should be taken into consideration in the Quest simulations.

Table 2: Skill levels of EU10 migrants: Comparison with other migrants into UK and with "local" UK workers (% of employed working age population)

	Total Population (2007)	Migrants into UK		
		1998-2003 (All Migrants)	2004-2006 (All Migrants)	2004-2006 (EU10 Migrants)
High Skilled (Professional & managerial occupations)	42.8	45.4	32.3	11.2
Medium Skilled	38.6	32.4	28.0	26.2
Low Skilled (Process, plant & machine operatives & elementary occupations)	18.6	22.3	39.7	62.6

Source: NIESR

3. Assessment of the economic implications of migration using the Quest model: The Quest model (see model description in annex 3) is used to assess the macroeconomic impact of the EU10 migration flows which occurred over the period 2004-2007, with the broad implications for both the receiving (EU15) and sending (EU10) countries being taken into account. The simulations are based on the following specific set of assumptions:

[10] S. Kirby, J. Mitchell and R. Riley (NIESR) : Evidence submitted to the inquiry into "The Economic Impact of Immigration" being conducted by the House of Lords Select Committee on Economic Affairs.

[11] This does not necessarily imply that EU10 migrants are low skilled, with indeed a lot of evidence pointing to the opposite conclusion that many of the recent EU10 migrants are over-qualified for the jobs they are doing. This phenomenon is often referred to as "brain waste". However this "brain-waste" / over-qualification issue is more often associated with temporary migration flows whereas the simulations in the present paper are carried out under the assumption that migration flows are more permanent in nature.

- The first simulation assumes that there are no dramatic differences in the skill distributions between the migrant and local populations i.e. EU10 migrants do not alter the skill structure of the EU15's labour force. In addition, it is implicitly assumed that migrants increase more than proportionally the labour force i.e. that the migrant population has a higher participation rate than the average for the EU15.

- For the second simulation, the skill distribution assumption is relaxed to reflect the increasing evidence that a significantly larger share of the jobs being occupied by EU10 migrants in EU15 countries are at the low end of the skill range.

Simulation 1 – No differences in the skill characteristics of migrant and "local" workers: The main results from simulation 1 are shown in Table 3. These should be interpreted as medium to long run permanent effects (i.e. after about 10 years when the domestic capital stock has partially adjusted to the changes in the labour supply) of a migration shock broadly similar in magnitude to that which has been experienced to date. In this regard, whilst the cumulative EU10 migration outflow over the period 2004-2007 is around 1 million (i.e. roughly equivalent to 0.4% and 2% of the EU15's and EU10's working age populations), the results shown in Table 3 refer to a slightly larger shock of 0.5% / 2.5% for the EU15 and EU10 respectively.

As with ECFIN's own 2001 assessment, the cumulative EU10 migration figures used in the simulations are also quite close to the estimates of potential migration from the new Member States into the EU15 contained in Boeri and Brücker (2005) for the specific years 2004-2007. In addition, Boeri et al. go on to predict, on the assumption of no migration barriers, that the long run (i.e. in 2030) migration potential is around 3 million (i.e. 1.2% and 6% of the EU15's and EU10's working age populations respectively). Consequently, any long run analysis would need to assume permanent EU10 migration flows which are roughly 2 1/2 times greater than those which are assumed for the simulation results in table 3, a not unreasonable assumption given the EU10-related migration restrictions which continue to be enforced in some large EU15 Member States such as Germany.

For the present shorter run analysis up to 2007, and based on a migration shock of 0.5% / 2.5% for EU15 / EU10, Table 3 shows that the overall EU25 GDP effect of the 2004-2007 flows are substantial and positive at 0.27%. This GDP effect is equivalent to a collective income gain of around €30 billion for the citizens of the 25 Member States. A migration shock of this magnitude would consequently be much more potent, in economic terms, than for example a 1 percentage point increase in the EU25's investment to GDP ratio. In fact, on the basis of the long run potential migration estimate of Boeri et al., internal EU25 migration flows could produce gains which are higher than those likely to be achieved from the further economic integration of the EU25's goods and capital markets.

These highly positive effects from international migration within the EU25 are in keeping with the view that migration increases the productive use of human resources within the area as a whole and hence adds strongly to GDP. This positive efficiency effect is shown in the GDP per capita[12], productivity and real compensation of employees figures provided in the table, with real wages tending to grow in line with productivity over the long run. With respect to the other labour market variables focussed on in the simulation, the positive

[12] This is an important indicator of the effect of migration on living standards since migration not only changes GDP in the receiving and sending countries but also their respective overall populations.

employment rate effect reflects small positive gains for the unemployment rate / NAIRU[13] in the EU25 as a whole, with migrants tending to move from countries with relatively high unemployment rates to countries where rates are generally lower. Moreover, whilst there are some short run public finance and balance of payments effects associated with the migration shock (most notably with respect to emigrants' remittances), the magnitude of the effects over the longer run is extremely small.

Table 3: Medium to Long Run Economic Effects of a 0.5%/2.5% Migration Shock on Receiving (EU15) and Sending (EU10) Member States (Assumption : No change in skill distributions between migrant & local populations)

	GDP	GDP per capita	Productivity	Real Compensation of Employees	Employment Rate	Public Finances / Balance of payments
EU15	0.38	-0.12	-0.13	-0.12	0.01	Neglible
EU10	-2.23	0.28	0.42	0.46	-0.14	Neglible
EU25	0.27	0.27[14]	0.27	0.28	0.04	Neglible

Source: ECFIN (Quest simulations)

Regarding the distribution of the gains between the receiving (EU15) and sending (EU10) groups of countries, Table 3 summarises their contrasting fortunes. For the EU15, whilst migration from the EU10 countries has added to its labour force growth, implying an increase in its long term growth potential, the effect on its GDP per capita is slightly negative (i.e. around -0.1). This GDP per capita effect reflects the lower productivity / lower real wages associated with the migration shock, with labour becoming more abundant relative to capital,

[13] Table 3 does not explicitly show effects on the unemployment rate. This reflects the fact that Quest only includes estimates for the impact on the employment rate, with no attempt to distribute changes in the employment rate into those coming from changes in participation rates or in structural unemployment rates. In the case of the migration simulations, it is reasonable to assume that most of the changes in the employment rate emanate from changes to participation rates, with any short term effects on the NAIRU being cancelled out over the very long run (i.e. more than 20 years) once the physical capital stock in the affected countries has adjusted fully to the migration flows.

[14] The GDP per capita gain at the EU25 level may appear initially surprising given the negative impact of migration on EU15 GDP per capita. The explanation however is straightforward since the EU25 effect is not the simple weighted sum of the impact on the EU15 and EU10 aggregates – it also takes account of important composition effects. Whilst the average EU15 GDP per capita effect is negative, one must allow for the fact that there is now roughly 1 million additional EU10 workers in EU15 countries which have increased their incomes substantially (according to some estimates by 100% or more). This composition effect must be taken into account at the EU25 level where, for example, if one assumes that 1 million workers are now earning salary levels close to the EU25 average, as opposed to the average of the salary levels in EU10 countries (i.e. an average per capita gain of roughly €20,000), this effect alone would add close to €20 billion to EU25 income.

provoking a reduction in the capital intensity of production in the EU15[15]. With respect to the employment rate impact, Table 3 shows a positive effect for the EU15 countries, with this essentially reflecting the impact of participation rate changes since changes to the unemployment rate (i.e. the NAIRU) will tend to disappear over time as the physical capital stock adjusts.

With respect to the effects on the sending (EU10) countries, Table 3 shows negative effects on GDP of 2 ¼ % but capital deepening induced gains for real wages, productivity and GDP per capita. The higher impact on productivity / real wages compared with GDP per capita is explained by the decline in the EU10's employment rate. This decline reflects the impact of negative wealth effects[16] on EU10 labour force participation rates, with lower participation / employment rates ensuring that the GDP per capita gains are more subdued relative to productivity.

Table 4 shows the effects of the migration shock on nominal variables. In the EU15, post-enlargement migration leads to a decrease in the price level of -0.42% over 10 years, corresponding to an average yearly effect on inflation of about -0.04%. This reduction in inflationary pressures in the receiving countries is driven by a drop in nominal wages, which decrease by -0.54%. In other words, immigration into the EU15 countries is expected to raise the supply potential of the host economies to a greater degree than its effects in raising aggregate demand. These effects work essentially the other way around in the EU10 countries, with the rise in nominal wages in the EU10 as a whole being associated with a price level increase of 3.56% (which corresponds to an average yearly increase in the inflation rate of the sending countries of approximately 0.36%).

Table 4: Medium to Long Run Nominal Economic Effects of a 0.5%/2.5% Migration Shock on Receiving (EU15) and Sending (EU10) Member States (Assumptions as in Table 3)

	Price level	Average yearly inflation	Nominal wages
EU15	-0.42	-0.04	-0.54
EU10	3.56	0.36	4.05

Source: ECFIN (Quest Simulations)

[15] This prediction of a capital intensity driven productivity effect in the receiving countries may well be a factor explaining the slow productivity growth rates of a number of high inward migration countries such as Spain.

[16] These wealth effects are underpinned by higher productivity in the EU10 countries, with these productivity gains reflecting the fact that the capital stock is now spread over a smaller number of workers (due to outward migration). In addition, there may be some additional wealth effects from emigrants' remittances but since we are assuming that the migration shock is permanent, the effect on remittances is likely to be small. This is borne out by studies which suggest that remittances associated with short term migration may be very high but that long run migration has substantially lower income transfers to the home country.

Simulation 2 – Allowing for differences in the skill characteristics of migrant and "local" workers: The economic consequences of migration depend not only on the scale of the flows but also on the skill characteristics of migrants versus natives in the host country, with big differences in the effects depending on whether a country receives high or low skilled workers. According to Brücker (2007), "as a rule of thumb, natives in the receiving countries tend to win if the migrant labour force has at least the same skill level as the native labour force and to lose in the converse case" … (regarding the converse case) "those at the bottom of the income distribution in the sending countries win from migration through lower unemployment and higher wages, those at the bottom of the income distribution in the recipient countries tend to lose through lower wages and higher unemployment". Given that the factor of production labour in the Quest model can be split into its high, medium and low skilled components, it is possible to use Quest to check the validity of the Brücker view. In keeping with that view, table 5 shows that a change in the skill composition of the migrant EU10 workforce, for example with the EU15 countries employing a substantially higher share of EU10 migrants in low skilled jobs, can make a substantial difference to the simulation results.

Table 5 shows the effects on the EU15 and EU10 groupings if the share of EU10 migrants in low skilled jobs in the EU15 countries rises from 20% to 60% of the total. The table confirms that the GDP and GDP per capita gains for the EU25 as a whole for the "low skilled" variant are roughly 15-20% lower compared with simulation 1, with these effects in turn reflecting the less robust productivity / real wage performances and the lower employment rate associated with low skilled jobs. Regarding the impact on the receiving countries, the GDP gains in the EU15 are lowered relative to simulation 1. This in turn has important implications for the labour market effects, with the negative effect on real wages more pronounced and with the employment rate effect shifting from positive to negative. For the EU10 countries, the GDP per capita gains are almost double those of simulation 1, reflecting the much more favourable employment rate gains.

Table 5 also splits the real wage and employment effects for the EU15 and EU10 groupings into their respective high, medium and low skilled components. Whilst it is difficult to disentangle the various effects (especially the participation and unemployment rate impact on the employment rate), the results in table 5 can be interpreted as indicating higher rates of unemployment and lower real wage growth for the low skilled in the EU15, with broadly opposite effects for the EU10. In addition, the simulations indicate that the medium to long run negative effect of immigration on the wages of the unskilled in the EU15, and on the wages of high and medium skilled workers in the EU10, is relatively substantial and persistent. With respect to unemployment, the results in table 5 are consistent with the view that whilst the short run may be characterised by a slight temporary increase in the EU15's unemployment rate, the long run effects of the migration shock on the unemployment rate of recipient countries is very muted as the capital stock in the EU15 countries adjusts to the migration inflows.

Finally, it should be noted that it is assumed in simulation 2 that the EU10 migrants who take these low skilled jobs are in fact low skilled workers. This assumption may not always be justified since many of the migrants are often over qualified for the jobs they are doing (i.e. the "brain waste" phenomenon referred to earlier). We have made this assumption since such skill mismatches tend to be more of a feature of temporary migration flows, with workers moving for short periods of time to gain experience and then returning home. Our simulation assumes that the migration is permanent and consequently the mismatches may not be as

severe. In a separate simulation where the effects of skill mismatches are explicitly taken into account, not surprisingly the GDP per capita losses for the EU15 and the GDP per capita gains for the EU10 are lower compared with the results shown in table 5.

Table 5: Medium to Long Run Economic Effects of a 0.5%/2.5% Migration Shock on Receiving (EU15) and Sending (EU10) Member States (Assumption: 60% of migrants are in low skilled jobs vs. 20% for Simulation 1)

	GDP	GDP per capita	Real Compensaton of Employees				Employment rate			
			Total	High Skilled*	Medium Skilled*	Low Skilled*	Total	High skilled*	Medium Skilled*	Low Skilled*
EU15	0.31	-0.18	-0.16	0.08	-0.04	-0.45	-0.005	0.024	0.03	-0.1
EU10	-1.99	0.53	0.44	-0.68	-0.45	5.29	0.08	-0.17	0.04	0.31
EU25	0.22	0.22	0.25	0.44	0.29	0.14	0.06	0.05	0.08	0.01

***High skilled workers are defined as that segment of the labour force which can potentially be employed in the R&D sector, i.e. the share of the population with tertiary education qualifications in science, mathematics, computing or engineering programmes. Low skilled workers are defined as that portion of the labour force with ISCED (International Standard Classification of Education) levels 0-2. The rest of the labour force is categorized as medium skilled.**

Source: ECFIN (Quest simulations)

4. Comparison of Quest simulation results with those of other studies: In order to put the Quest results into perspective, the present section compares them with those of other studies which have assessed the economic impact of migration following the 2004 EU enlargement.

4.1: Cross country studies: Whilst the majority of cross country studies on post-enlargement migration deal with issues linked with the estimation of the size of actual flows, a number of them have concentrated on analysing the economic costs and benefits associated with the overall process. Whilst most of the latter studies find positive GDP gains for the EU25 as a whole, results vary considerably due to differences in the assumptions made with respect to the size of the migration flows; the speed of adjustment of the economy, both with respect to the labour market and the capital stock, and differences in the skill characteristics of migrant and "local" workers.

IAB (2008): As part of the European Integration Consortium, a recent 2008 study by the Institute for Employment Research (IAB) simulates the effects of migration from the EU10[17] member states within a general equilibrium framework and focuses on both the short and long run effects[18]. The migration shock is modelled as a change in the total population of the

[17] EU10 excluding Cyprus and Malta.

[18] The short run is characterised by a partial adjustment of the capital/labour ratio, whilst in the long run the capital stock is assumed to adjust completely to the labour supply shock.

receiving and sending countries and its magnitude is very close to the one considered in our own simulations. Table 6 reports the impact of the migration shock on key macroeconomic variables. The simulated impact on the GDP of the enlarged EU (i.e. EU25) is positive at 0.14% in the short run and 0.23% in the long run, with the long run impact driven by a strong positive GDP increase of 0.28% in the EU15 which is only partially offset by an even stronger negative effect of -1.06% for the EU-10 group of countries. These EU10, EU15 and EU25 effects are broadly in line with the Quest results reported earlier.

Table 6: Economic Effects of a Migration Shock on Receiving (EU15) and Sending (EU10) Member States
Results from IAB (2008) and Brücker (2007)

	GDP		GDP per capita		Real Compensation of Employees		Unemployment Rate	
	Short run	Long run*	Short run	Long run*	Short run	Long run*	Short run	Long run*
EU15								
IAB (2008)	0.17	0.28	-0.05	0.06	-0.08	0.00	0.04	0.01
Brücker (2007)	0.43 / 0.51	0.83 / 0.99	/	/	/	/	0.19 / 0.12	0.11 / 0.02
EU10								
IAB (2008)	-0.49	-1.06	0.63	0.05	0.24	0.00	-0.40	-0.02
Brücker (2007)	-0.42 / -0.63	-0.73 / -1.08	/	/	/	/	-0.25 / -0.11	-0.08 / 0.01
EU25								
IAB	0.14	0.23	0.14	0.23	-0.07	0.00	-0.04	-0.01
Brücker (2007)	0.19 / 0.20	0.40 / 0.42	/	/	/	/	-0.07 / -0.04	-0.07 / -0.03

*** Long run, steady state, effects of migration where, for example, capital intensity levels and wages have fully adjusted to the migration-induced changes in the labour supply. Adjustments to the capital stock can occur either via changes in domestic investment patterns or via shifts in international capital flows.**
Source: IAB (2008) and Brucker (2007)

The IAB study also finds that the migration shock is followed by a short run increase in the GDP per capita of the sending countries (which becomes substantially smaller in the long run) and by a negative short run effect on the GDP per capita of the receiving countries (which turns positive in the long run). The prediction of a long run positive effect on the per capita incomes of the receiving countries differs from our own simulation results. The IAB result can be explained by two specific assumptions: firstly, that there is full adjustment of the capital stock to the change in the labour supply over the long run and secondly that there is much higher participation rates amongst migrants compared to the populations of the receiving countries. Consequently, whilst in the short run the negative effect of having a lower capital endowment per capita prevails, this is more than offset in the long run by the higher participation rate of migrants which provides a positive boost to GDP per capita. These longer run, steady state, effects are not therefore comparable with those of the Quest simulations, since the latter are only run for a time horizon of around 10 years post-

enlargement, an insufficient length of time for the full adjustment of the capital stock to take place.

The IAB study also analyses the effects of the migration shock on labour markets. In the receiving countries, migration from the new Member States (NMS) leads in the short run to a small increase in the unemployment rate (0.04%) and to a small decrease in wages (-0.08), with both effects effectively disappearing in the long run. This compares with short run decreases in the unemployment rate (-0.40%) and an increase in wages (0.24%) in the sending countries, again with both effects disappearing over time. At the level of the enlarged EU, migration flows result in small, short run, decreases in both the unemployment rate (-0.04) and in wages (-0.07), with both these effects being at, or close to, zero in the long run. The study also finds that the group of workers in the EU15 whose wages are most negatively affected by inward migration are medium-skilled workers, reflecting the high concentration of migrants from the NMS which possess similar, mid-spectrum, skill levels.

The impact on unemployment found by IAB is consistent with our own simulations, which predict a similar positive impact on the EU25 employment rate, 10 years after enlargement. Concerning the effect on wages, we find that although they decrease in the receiving countries and increase in the sending countries (as in the IAB study), the overall effect at the EU25 level is positive (negative for IAB), with the latter result driven by the large initial wage differentials between the EU15 and EU10 member states. In terms of the impact on different skill groups, unlike IAB we find that the most affected group is low skilled workers. This is consistent with our assumption in simulation 2 that 60% of post-enlargement migrants are employed in low skilled jobs[19].

Brücker (2007): Brücker analyses the effects of migration from the NMS using a model with semi-rigid labour markets[20] and assumes a 1% immigration and emigration rate, compared with the rates of 0.5% and 2.5% respectively used for the Quest simulations. The simulations are carried out using various alternative shares for white-collar workers in the overall migrant labour force. The paper finds, in a scenario where the capital stock is fixed, that the migration shock has an overall positive effect on GDP (0.20%) in the EU25 as a whole, with this positive effect increasing with the share of white-collar migrants. This positive EU25 effect reflects the strong gains in the receiving countries (with GDP increasing by 0.43% / 0.51%). The substantially higher economic weight of the receiving countries in the overall EU25 total ensures that their gains more than offset the substantial GDP losses experienced by the sending countries (-0.42% / -0.63%).

[19] Drinkwater, Eade and Garapich (2006) compare the skill composition of post-enlargement migrants into the UK to those of earlier cohorts and find that the majority of recent migrants have found employment in low paying jobs. This finding is also confirmed by Riley and Weale (2006), who base their analysis on data from the Labour Force Survey. The tendency of post-enlargement migrants to take jobs which are not commensurate with their skill levels could, as Fihel et al. (2006) point out, be due to the often transitory nature of the migration flows. If a large part of the migration flows are temporary then gross flow figures would tend to be significantly larger than the change in stocks of residents. Indeed, evidence from some Member States indicates that many mobile workers go to another Member State for a few months or years but do not intend to stay forever. For example, data for the UK suggest that around half of those EU-8 citizens who have come to work in the UK since 2004 may have already left the country again, with a similar picture emerging for Ireland. Indeed, the most recent evidence suggests that mobility flows may have already peaked and return migration is on the rise.

[20] Brücker (2007) compares these results to those obtained using a model with completely flexible labour markets. These latter results will not be discussed here.

In addition, Brücker (2007) simulates the effects of the same migration shock but this time using the assumption that the capital stock fully adjusts to the labour supply shock, i.e. a scenario for the very long run. In this case, the positive impact on GDP is even more pronounced, varying between 0.40% and 0.42% in the enlarged EU25. The GDP effects on receiving (EU15) and sending (EU10) countries are respectively bigger and smaller than those reported in Tables 3 and 5 for the Quest simulations. They are not however directly comparable as the latter, as mentioned earlier, are based on a 0.5% migration shock for the receiving countries and a 2.5% shock for the sending countries.

Brücker (2007) shows that in the receiving countries, the unemployment rate increases by between 0.1% and 0.2%, varying with the skill level of workers. The higher the share of high skilled workers amongst migrants, the lower the increase in unemployment. This is in line with the Quest results reported earlier, with a small positive effect on employment being indicated when the skill composition of migrants matches those of the native population (table 3), compared with a slight negative effect when the majority of migrants are assumed to be low skilled (table 5). In keeping with the Quest results, Brücker (2007) also finds that the unemployment rate in the enlarged EU25 falls due to migration, driven by the movement of workers into countries with lower unemployment rates compared with their own home countries.

4.2 Individual country analyses: Other studies have focused on analysing the economic impact of post-enlargement migration on individual EU15 and EU10 countries, with a particular emphasis on those countries which have witnessed the biggest inflows or outflows (for example, the UK).

Barrell, FitzGerald and Riley (2007): Barrell et al. use a large estimated model (NiGEM) to simulate the effects of the post-enlargement migration shock for seven EU15 countries and for each of the EU10 countries (excluding Cyprus and Malta). The migration shock is measured in terms of the change in the stock of NMS nationals resident in the receiving countries over the period May 2004 to the third quarter of 2006. The use of this shorter time frame leads to estimates of the migration flows which are smaller than those used by our own and other papers (see, for example, the above mentioned IAB study).

The impact on the receiving countries' GDP, ten years after enlargement, varies between 0.09% in the case of Italy to 1.66% for Ireland. For the sending countries, the negative effect on GDP ranges between -0.04% for Slovenia and -1.05% for Poland. As in our own simulations, the model also predicts a decline in productivity in the host Member States, mirrored by a productivity increase in the NMS, due to the partial adjustment of the public and private capital stock. Moreover, the gradual adjustment of the capital stock leads to lower wages, lower inflation[21] and higher unemployment in the receiving countries. These effects tend however to disappear or become positive in the longer run.

With respect to GDP per capita developments, over the short run these are affected negatively in the receiving countries and positively in the sending countries. However, the negative GDP per capita effect in the destination countries becomes positive in the long run driven by an increase in the share of working age cohorts (i.e. 15-64 year olds) in the population as a whole.

[21] As in the Quest simulations reported in this paper.

Finally, Barrell, Fitzgerald and Riley (2007), on the basis of the evidence that the majority of NMS migrants are concentrated in low skilled jobs, also relax the hypothesis of identical productivity profiles for EU15 and EU10 workers and assume instead that migrants are less productive than natives. The simulations show that in this instance the effects of migration are more subdued compared with the central hypothesis, with on the one hand EU15 countries tending to gain less from migration in terms of GDP and, on the other, EU10 countries reducing their GDP losses.

Iakova (2007): Iakova analyses the effects of migration from the NMS to the United Kingdom using a dynamic general equilibrium model with a finite planning horizon[22] where the age structure of the population affects the effective labour supply through changes in productivity, earnings and the participation rate. The age structure also affects the demand side, as younger age groups tend to be net borrowers whereas those in middle age tend to be net savers, with the latter principally driven by their need to save for retirement.

The immigration shock is modelled as an increase in the number of young people in the UK economy. In this scenario, aggregate GDP increases over all time horizons due to the permanent nature of the shock. The initial negative effect on GDP per capita is offset in the longer term by an increase in the productivity of younger workers. In overall terms, the simulations show that NMS migrants are likely to contribute positively to the UK economy with respect to a range of variables including GDP growth, capital accumulation, consumption and the public finances.

5. Summary and Conclusions

In many EU Member States, the 2004 enlargement process sparked concerns that there could be a massive surge of workers from poorer central and eastern European countries flooding into the labour markets of the old EU15 Member States and impacting negatively on the wages and employment prospects of local workers. On the basis of the analysis in the present paper, many of these concerns appear to be largely unfounded.

The exact size of post-enlargement mobility flows is of course difficult to determine due both to several shortcomings in the existing data and to the largely open borders which exist between Member States. However, the available population statistics, as well as data from the EU's Labour Force Survey, suggest that since 2004 the stock of EU10 citizens resident in the EU15 has essentially doubled over the period to 2007 from roughly 1 to 2 million. While these numbers are significant in absolute terms, they represent – with the notable exception of Ireland - a relatively small share of the working-age population of the host countries. In fact, in almost all of the EU15 Member States the number of recent arrivals from countries outside the EU25 substantially exceeds the numbers arriving from the EU10 Member States. Moreover, in most of the EU15 countries, the inflow of other EU15 nationals has also been larger than the number of recent arrivals from the EU10.

Overall, these mobility flows have clearly contributed to growth. Our results suggest that the GDP effect on the EU25 as a whole of recent intra-EU mobility has been substantial and positive at about 0.3% of GDP. This is equivalent to an income gain of around €30 billion for the enlarged EU. Thus, a migration shock of this magnitude is in fact much more potent, in

[22] The Multimod model, developed at the IMF.

economic terms, than a 1 percentage point increase in the EU25's investment to GDP ratio. This positive effect from cross-border mobility within the EU25 is in keeping with the view that migration increases the productive use of human resources within the enlarged area and hence adds to GDP as well as boosting productivity and GDP per capita. Moreover, in line with other studies and the recent Communication from the European Commission on the impact of the free movement of workers in the context of EU enlargement, it can be concluded that post-enlargement intra-EU mobility flows have not led - and are unlikely to lead - to serious labour market disturbances at the total economy level, with respect to both real wages and unemployment trends. Finally, the present paper suggests that the balance of payments and public finance implications of the post-2004 migration flows are generally negligible, at least with respect to migration flows of a more permanent nature.

However, whilst positive for the EU25 as a whole, the analysis also shows that migration has potentially less clearcut effects for the receiving (EU15) and sending (EU10) groups of countries. For example, whilst the receiving countries are expected to gain in GDP terms, the effects on GDP per capita, real wages and the employment rate are more ambiguous, with gains dependent on the time horizon chosen for the simulations and the assumptions regarding both the skill characteristics of migrant and native labour as well as for the overall speed of adjustment of economies. For the sending countries, the simulation results point to the possibility of some negative effects on total GDP which must be balanced against capital deepening induced gains for real wages, productivity and GDP per capita. Moreover, it suggests that whilst labour mobility from the new Member States has helped to reduce inflationary pressures in most receiving countries, it has also contributed to emerging labour shortages and a (temporary) increase in inflation in some of the main sending countries.

Despite the caveats raised in the preceding paragraph, it is certainly fair to conclude from the present paper that the overall impact of post-enlargement mobility flows has been positive, with any negative effects for individual countries or for specific skill groups generally being both small in magnitude and time limited. The results of the paper also support the view that migration has a key role to play in realising the full benefits of an integrated economic area in the EU as a whole. In this respect, it is necessary to stress that a commitment to the free movement of workers remains perhaps the most symbolic and important of the four fundamental freedoms of the EU's internal market programme.
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Annex 1: EU25 Member States: GDP, GDP per capita and price level effects

At the Member State level, the degree of migration exposure of EU15 countries to EU10 migrants varies quite significantly and consequently the associated economic effects differ across countries (see Table 1 in main text and the more detailed analysis in Annex 2 for an overview of the migration flows).

Table 1: Medium to Long Run Country Specific Effects Based on the Change in the number of EU10 citizens resident in individual EU15 countries over the period 2004-2007 (Same assumptions as for Simulation 1 in main text)

	GDP	GDP per capita	Price level
Receiving Countries			
Belgium	0.22	-0.07	-0.24
Denmark	0.06	-0.02	-0.07
Germany	0.14	-0.04	-0.15
Ireland	4.23	-1.33	-4.67
Greece	0.07	-0.02	-0.08
Spain	0.17	-0.05	-0.18
France	0.01	-0.002	-0.01
Italy	0.06	-0.02	-0.07
Luxembourg	n.a.	n.a.	n.a.
Netherlands	0.11	-0.04	-0.13
Austria	0.35	-0.11	-0.39
Portugal	n.a.	n.a.	n.a.
Finland	0.13	-0.04	-0.14
Sweden	0.15	-0.05	-0.17
UK	1.00	-0.32	-1.11
Sending Countries			
Czech Republic	-0.53	0.07	0.85
Estonia	-1.33	0.17	2.12
Cyprus	0.00	0.00	0.00
Latvia	-3.52	0.44	5.62
Lithuania	-4.66	0.58	7.43
Hungary	-0.39	0.05	0.63
Malta	0.00	0.00	0.00
Poland	-2.07	0.26	3.30
Slovenia	-0.07	0.01	0.11
Slovakia	-2.10	0.26	3.36

Source : ECFIN (Quest simulations)

Annex 2: More detailed analysis of EU Migration flows and the changes which occurred following the May 2004 enlargement

Large quality problems with migration data: International migration data in general is of poor quality, with flows being highly volatile and with inadequate cross country harmonisation in the national practices used to collect the underlying immigration and emigration statistics[23]. The increase in intra-European mobility, the rise of both illegal migration and in the numbers of asylum seekers has added to the complications associated with the calculation of migration flows. Despite the problems, however, some progress has been made in recent years in improving the quality and international comparability of migration data, especially on the immigration side. The text which follows looks firstly at the different sources for migration statistics and secondly provides an overview of the data used for the "enlargement at five" simulations.

1. Choice of migration sources which could be used for the simulations:

- **Immigration data (receiving countries)**: Internationally comparable definitions of the immigrant population use criteria which are based either on nationality (i.e. citizenship) or on country-of-birth (i.e. persons residing in a country but born in another country). Differences across countries between the size of the "foreign" population (i.e. based on citizenship) and that of the "foreign-born" (i.e. based on country-of-birth) depends on the various national rules governing the acquisition of citizenship in the host country, with these variations in the rules leading to gaps between the two series. In general, the nationality based criterion gives substantially lower percentages for the immigrant population than does the foreign born criterion (for example, for the Netherlands, the foreign population as a percentage of the total population in 2005 is estimated by the OECD to have been 4.2%, whereas the share for the foreign-born population was 10.6%). For the purposes of the model simulations, the **citizenship** based criterion is used to compare the number of foreigners resident in the EU-25 member states over the period 2003-2007. This criterion has been used in preference to the country-of-birth criterion for the following reasons:

    - 1) firstly, in the context of post-2004 migration flows, citizenship is the criterion which is applied to the transitional arrangements allowing the existing Member States to temporarily restrict the free movement of workers into their labour markets;

    - 2) secondly, the citizenship criterion is more conceptually consistent with migration data derived from the Labour Force Survey, a source which is extensively used for migration analyses;

[23] According to the IMF's Regional Economic Outlook for Europe (October 2008), "The measurement of labor flows across borders is subject to various data limitations (availability, timeliness, precision and quality). For example, migration registration systems reliant on changes in permanent residency may underestimate flows when foreign workers maintain their residency status while working abroad. Also, population censuses and labor force surveys may not capture temporary and irregular flows. Moreover, workers' registration and other administrative systems in recipient countries may produce double counting and suffer from cross-country comparability. Worker registration systems, for example, may not be able to ensure that workers deregister when they leave the destination country. This would cause the measure of inflows to be overstated."

- 3) finally, since the simulations are focussing more on the effects of recent migration flows (i.e. 2004-2007) rather than on the overall stock of migrants living in the Member States, using citizenship rather than country-of-birth statistics is unlikely to seriously bias the overall results. This lack of bias reflects the fact that very few of the recent migrants have yet acquired citizenship rights in the receiving countries and consequently the gap between the numbers of "foreign-born" and "foreign" migrants is likely to be small.

- **Emigration data (sending countries)**: In principle, emigration from country A to country B should be identical to immigration into country B from country A. However, this is far from the case with the emigration statistics for many of the EU's member states, with large discrepancies reflecting political factors which heighten or lower the degree of enthusiasm of the respective statistical authorities to collect such information. These discrepancies are in fact very large, with official emigration data for the new Member States equalling only a small fraction of the estimated number of EU10 immigrants coming into EU15 countries over the period 2004-2006. Given these large discrepancies between the emigration and immigration datasets and the fact that the quality and international comparability of the immigration data has improved significantly in the Member States in recent years (due to the fact that countries now identify both the "foreign" and "foreign-born" resident populations in their national censuses), there is consequently a strong case for trying to reconcile the emigration data with the more robust immigration data. Whilst such an exercise will always be crude, it is nevertheless essential given the need to ensure logical coherence between the immigration and emigration data sources used for the purposes of the migration simulations. For the present exercise, reconciliation is achieved simply by taking the total for EU10 immigration into the existing EU15 countries and making this equal to the total emigration of EU10 citizens into EU15 countries. With respect to the country breakdown of the flow of EU10 emigrants into EU15 countries, a rough estimate is made for 8 of the 10 new member states (the exceptions being Cyprus and Malta where it is assumed that there is no change in the flow of migrants following enlargement) using an IMF breakdown[24] for the flow of emigrants from these countries into those EU15 countries which were first to open their labour markets to EU10 workers after May 2004, namely the UK, Ireland and Sweden.

2. Overview of the migration data for the EU15 (Receiving) and EU10 (Sending) Member States used for the simulations:

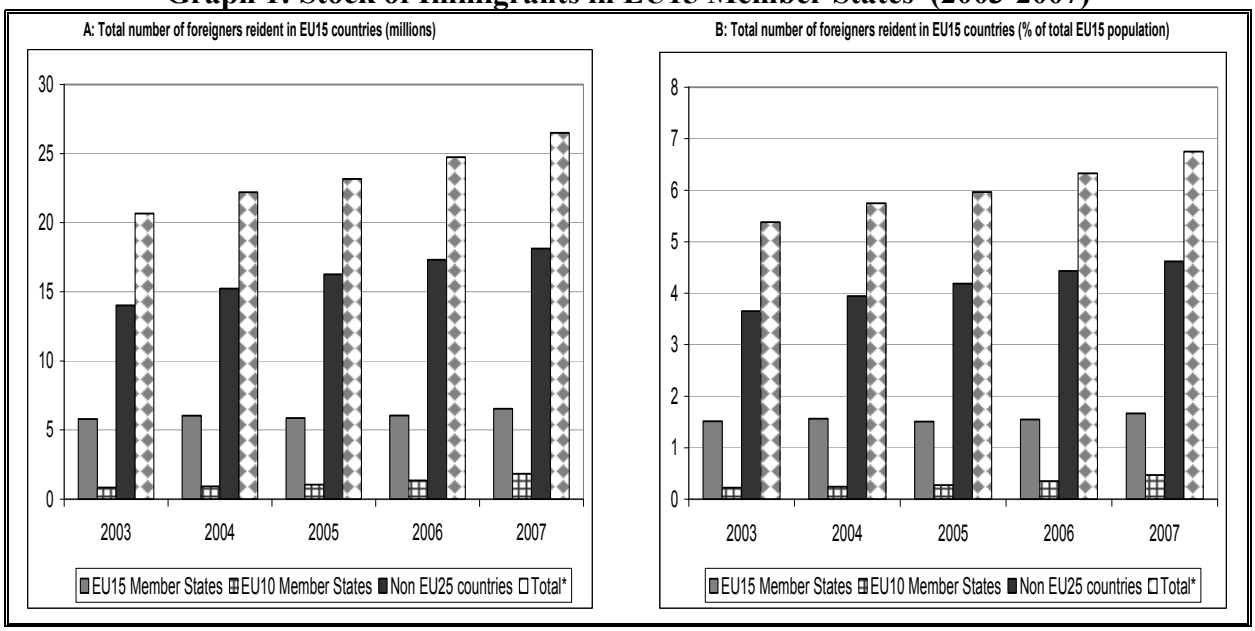
2a) Changes in Immigration Patterns for the EU15 Member States following the 2004 Enlargement: To what extent have the pre-enlargement fears that migration from the relatively poorer new Member States into the EU15 countries would grow enormously after May 2004? On the basis of the most recently available immigration statistics (based on citizenship) from Eurostat for the period 2003-2007, the following points can be made about the numbers of foreigners, including EU10 citizens, which were resident in the EU15 Member States over that period:

- **Stock of Immigrants in EU15 Countries**: With respect to the overall stock of foreigners living in the EU15 member states, this rose from 20.7 million in 2003 to

[24] See "Migration in EU8 Countries", a note prepared by M. Tirpak in the IMF Regional Office in Warsaw (July 2007).

26.5 million in 2007 (graph 1a). As a share of the EU15's total population, this was equal to an increase of 1 ¼ percentage points from 5.4% to 6.7% over the four year period 2003-2007 (graph 1b). With respect to the breakdown of the total into the 3 groupings shown in the graphs (i.e. immigrants from other EU15 countries; from EU10 countries and from non-EU25 countries), graph 1a shows that over 2/3 of the foreigners living in the EU15 are from non-EU25 countries, with roughly a quarter from other EU15 member states and with less than 8% from the new Member States. As a share of the EU15's total population, graph 1b shows that whilst the share of EU10 citizens has risen over the period 2003-2007 from 0.2% to 0.5%, this increase is substantially less than that for the non-EU25 countries which now represent 4.4% of the EU15's total population compared with a share of 3.7% in 2003. Consequently, whilst there has been a notable increase in the stock of EU10 immigrants in EU15 countries over the period since enlargement, on the basis of the above statistics, it is clear firstly that the numbers involved are not substantial as a share of the EU15's total population (i.e. ½% of the total) and secondly that their share is small relative to that of the non-EU25 countries (i.e. 4 ½% of total).

Graph 1: Stock of Immigrants in EU15 Member States (2003-2007)



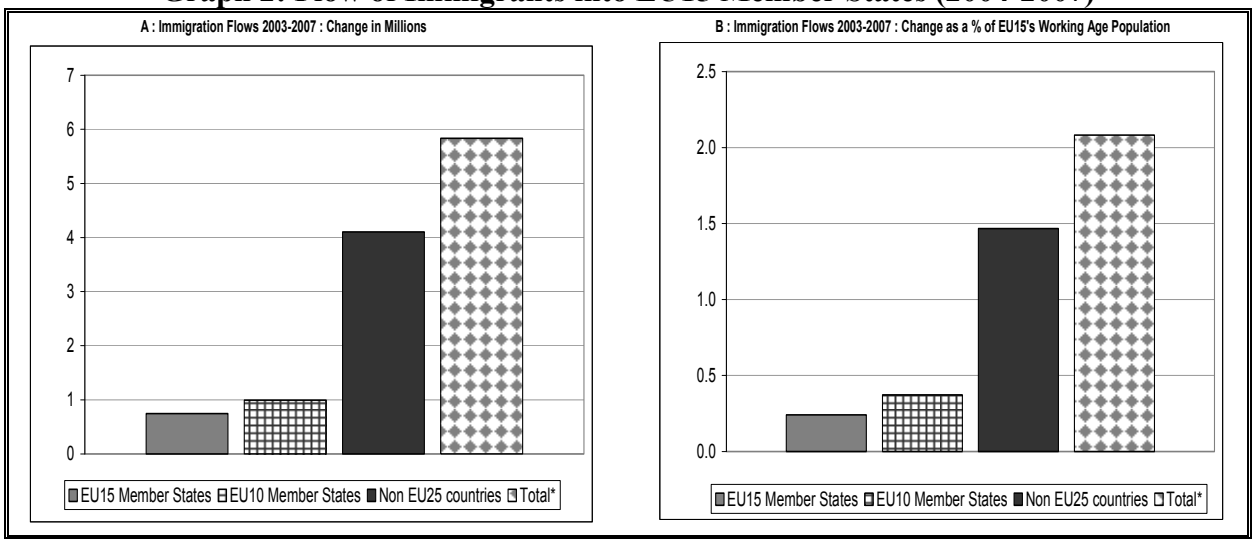
Source: Eurostat and ECFIN calculations

- **Flow of Immigrants into EU15 Countries**: With respect to the change in the stock of immigrants in the EU15 countries over the period since the 2004 enlargement, graph 2a shows that of the total increase of nearly 6 million in the number of foreigners living in EU15 countries, roughly 1 million came from the new Member States (i.e. 17% of the total number of foreigners). This compares with an increase of ¾ of a million (13% of the total) from other EU15 countries and over 4 million from outside the EU25 (70% of total). Graph 2b shows that foreign immigrants increased the EU15's working age population by roughly 2% over the period 2003-2007[25], an annual increase of ½ a percentage point. Of these totals, immigrants from the new

[25] Based on the plausible assumption that all recent immigrants from the EU10 countries were in the 15-64 age cohort (i.e. were of working age).

member states added 0.37% to the EU15's working age population[26] over the period which is equivalent to an annual increase of less than 0.1%.

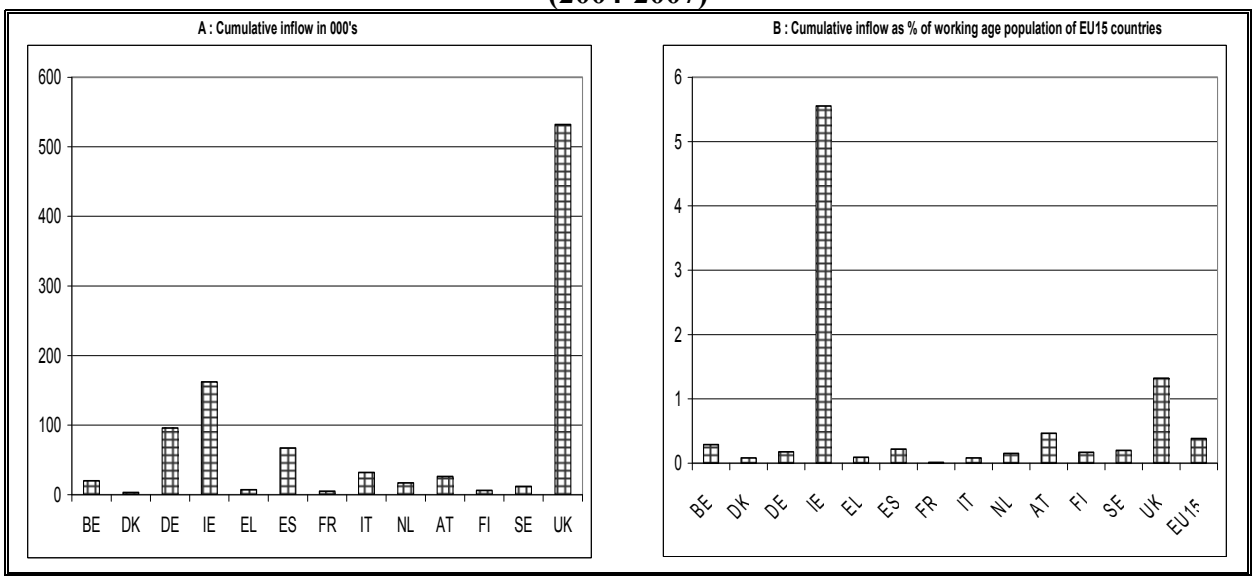
Graph 2: Flow of Immigrants into EU15 Member States (2004-2007)



Source: Eurostat and ECFIN calculations

- **Cumulative Inflow of EU10 Immigrants into Individual EU15 Countries**: While the EU15's total working age population was only increased by 0.37% over the period 2003-2007 due to inflows from EU10 countries, graph 3 shows that the individual EU15 country experiences were very different, with countries such as Ireland and the UK experiencing substantially larger inflows. The situation of Ireland is particularly striking, with EU10 workers boosting the Irish working age population by over 5% over the period 2004-2007 (an average annual increase of around 1 ¼%).

Graph 3: Cumulative inflows of EU10 Immigrants into individual EU15 countries (2004-2007)



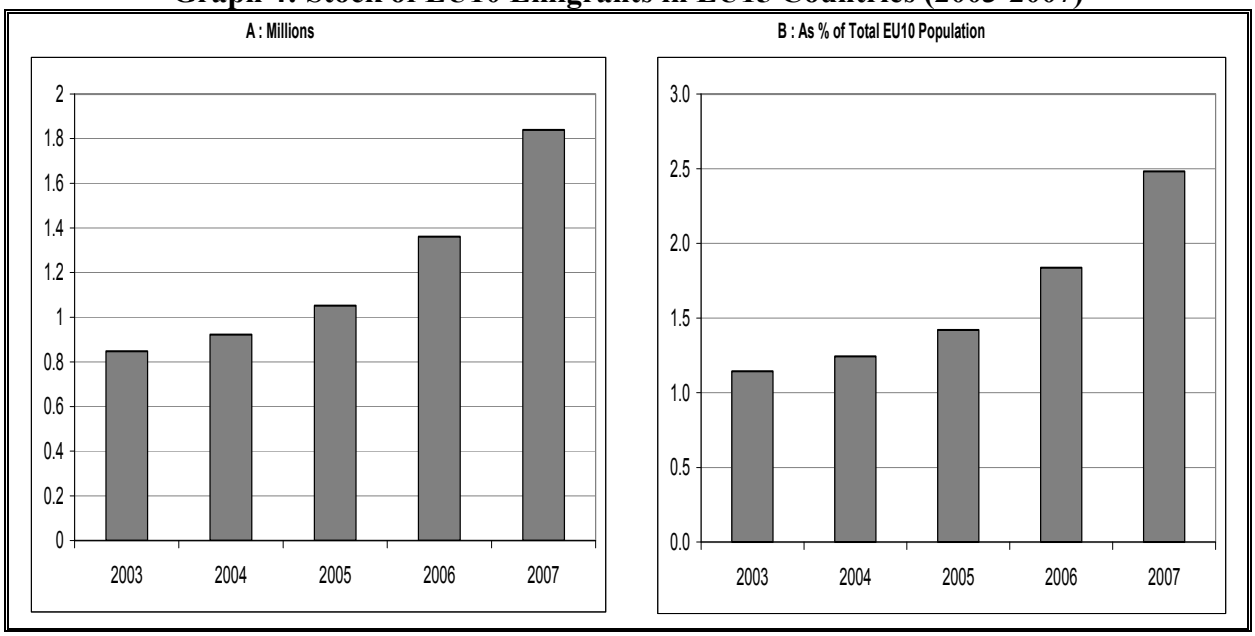
Source: Eurostat and ECFIN calculations

[26] This figure of 0.37 compares with the forecast in ECFIN's 2001 study on enlargement of an increase of 0.35 percent of the EU15's working age population over the period to 2010.

2b) EU10 Emigration Patterns: As explained earlier, the EU10 emigration figures were adjusted to ensure that they equalled the EU10 immigration figures into the EU15 Member States. On the basis of this reconciliation of the immigration / emigration statistics, the following points can be made concerning the impact of emigration on the EU10 countries:

- **Stock of EU10 Emigrants in EU15 Countries**: As shown in graph 4a, roughly 1.8 million EU10 citizens are residing in EU15 countries. This is equivalent to about 2 ½% of the total EU10 population (graph 4b).

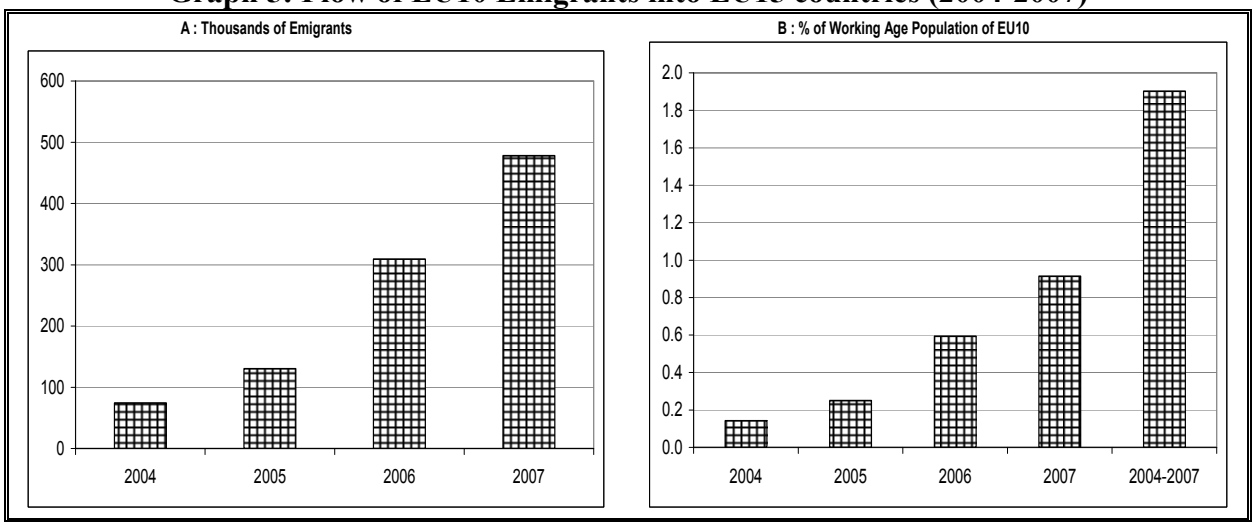
Graph 4: Stock of EU10 Emigrants in EU15 Countries (2003-2007)



Source: Eurostat, IMF and ECFIN calculations

- **Flow of EU10 Emigrants into EU15 Countries**: Graph 5a shows that 1 million of the total of 1.8 million EU10 citizens living in EU15 countries migrated since 2003, with this equivalent to an "official" outward flow of about 2% of the EU10's working age population over the four year period 2003-2007 (i.e. an annual average outflow of ½ % a year (graph 5b)).

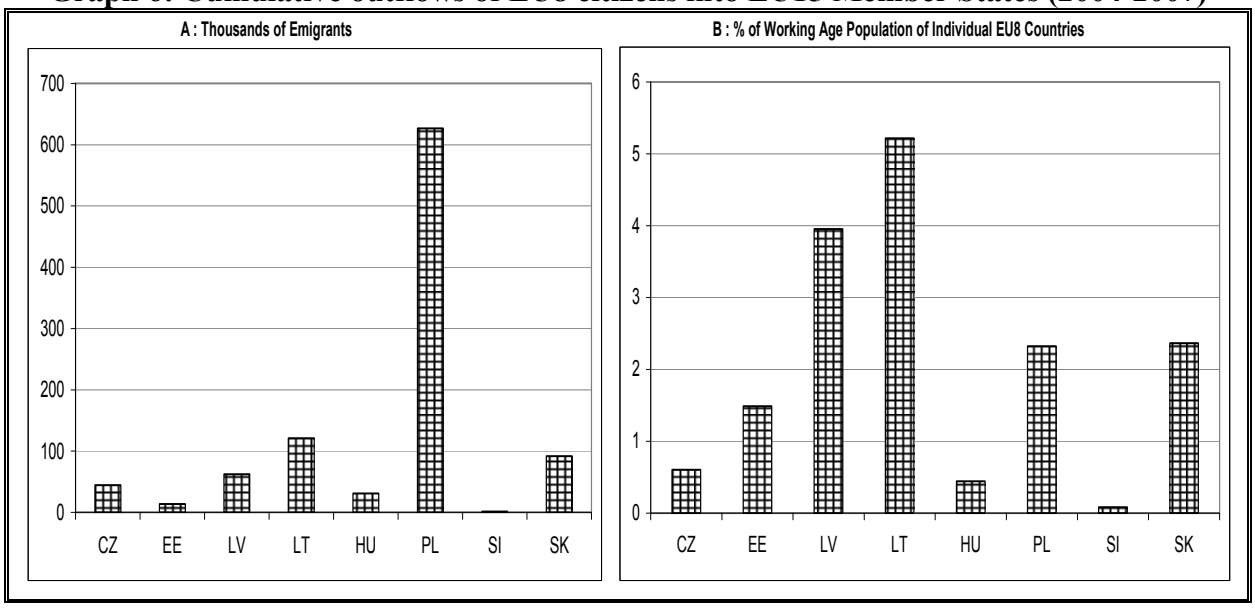
Graph 5: Flow of EU10 Emigrants into EU15 countries (2004-2007)



Source: Eurostat, IMF and ECFIN calculations

- **Cumulative Emigration Flows out of Individual EU10 countries**: In order to get an idea of the effects of this outward movement of workers on individual EU10 countries, we make use of an IMF study (op.cit.) of migration trends in eight of the countries (the exceptions being Cyprus and Malta). The IMF study included estimates of the cumulative emigration out of these 8 new member states (EU8) into those EU15 countries which immediately opened their labour markets to EU8 workers following the enlargement in May 2004 (i.e. the UK, Ireland and Sweden). Graph 6 uses data from the IMF study to show that Latvia, Lithuania, Poland and Slovakia were the EU8 countries which experienced the greatest outflows[27], especially when emigrant flows are measured as a share of the working age population of the EU8 country in question (graph 6b).

Graph 6: Cumulative outflows of EU8 citizens into EU15 Member States (2004-2007)



Source: Eurostat, IMF and ECFIN calculations

[27] This conclusion is in keeping with that of Fihel et al. (2006) and Barrell et al. (2007).

Annex 3: Quest Model Description

The model consists of households, final and intermediate goods producing firms, a research sector, a monetary authority and a fiscal authority. In the final goods sector, firms produce differentiated goods which are imperfect substitutes for goods produced abroad. Final goods are produced by making use of a composite of domestic and imported intermediate goods and three types of labour: low-, medium- and high-skilled. The R&D sector produces designs in research labs, employing high skilled labour and using the existing stock of domestic and foreign ideas. Firms in the intermediate sector are monopolistically competitive and produce intermediate goods from rented capital input using the designs licensed from households, who buy them from the R&D sector. In what follows, the structure of the household and the production sectors is described in some detail[28].

1 Households

The household sector consists of a continuum of households, which denoted by $h \in [0,1]$. A share (1-ε) of the households are not liquidity constrained. These households have full access to financial markets, accumulate physical capital and buy patents of designs from the R&D sector. Non liquidity constrained households supply medium- and high-skilled labour services indexed by $s \in \{M, H\}$. The remaining share ε of households is liquidity constrained. They do not trade on assets markets and consume their disposable income each period. Liquidity constrained households offer low-skilled labour services only. For each skill group, both types of households supply differentiated labour services to unions which act as wage setters in monopolistically competitive labour markets. Households also face adjustment costs for changing wages.

1.1 Non liquidity constrained households

Non liquidity constrained households maximise an intertemporal utility function in consumption and leisure subject to a budget constraint. Within each skill group, the households make decisions about consumption (C_t^i), labour supply ($L_t^{i,s}$), investments into domestic and foreign financial assets (B_t^i and $B_t^{F,i}$), the purchases of investment good (J_t^i), the renting of physical capital stock (K_t^i), the corresponding degree of capacity utilisation ($ucap_t^i$), the purchases of new patents from the R&D sector ($J_t^{A,i}$), and the licensing of existing patents (A_t^i). They also receive wage income (W_t^i), unemployment benefits ($b_t^s W_t^{i,s}$), transfer income from the government (TR_t^i) and interest income (i_t, i_t^K and i_t^A).

Hence, non-liquidity constrained households face the following Lagrangian[29]

[28] For a comprehensive description of the model, see Roeger et al. (2008).

[29] The budget constraints are written in real terms with all prices and wages normalized with P_t, the price of domestic final goods.

(1)

$$\underset{\left\{\begin{matrix} C_t^i, L_t^i, B_t^i \\ B_t^{F,i}, J_t^i, K_t^i \\ J_t^{A,i}, A_t^i, ucap_t^i \end{matrix}\right\}_{t=0}^{\infty}}{Max} \quad V_0^i = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left(U(C_t^i) + \sum_s V(1 - L_t^{i,s}) \right)$$

$$- \mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^i \beta^t \left(\begin{array}{l} (1+t_t^c) P_t^C C_t^i + B_t^i + E_t B_t^{F,i} + P_t^I \left(J_t^i + \Gamma_J (J_t^i) \right) + P_t^A J_t^{A,i} \\ - (1+r_{t-1}) B_{t-1}^i - \left(1 + r_{t-1}^F - \Gamma_{B^F} \left(E_t B_{t-1}^F / Y_{t-1} \right) \right) E_t B_{t-1}^{F,i} \\ - \sum_s \left(1 - t_t^{w,s} \right) W_t^{i,s} L_t^{i,s} - b_t^s W_t^{i,s} (1 - NPART_t^{i,s} - L_t^{i,s}) + \Gamma_W (W_t^{i,s}) \\ - (1 - t_{t-1}^K) \left(i_{t-1}^K ucap_{t-1}^i - rp_{t-1}^K - \Gamma_U \left(ucap_{t-1}^i \right) \right) P_t^J K_{t-1}^i - t_{t-1}^K \delta^K P_t^I K_{t-1}^i - \tau^K P_t^I J_t^i \\ - (1 - t_{t-1}^K) (i_{t-1}^A - rp_{t-1}^A) P_t^A A_{t-1}^i - t_{t-1}^K \delta^A P_t^A A_{t-1}^i - \tau^A P_t^A J_t^{A,i} \\ - TR_t^i - \sum_{j=1}^n PR_{j,t}^{f,i} - \sum_{j=1}^{A_t} PR_{j,t}^{x,i} \end{array} \right)$$

$$- \mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^i \xi_t^i \beta^t \left(K_t^i - J_t^i - (1 - \delta^K) K_{t-1}^i \right) - \mathrm{E}_0 \sum_{t=0}^{\infty} \lambda_t^i \psi_t^i \beta^t \left(A_t^i - J_t^{A,i} - (1 - \delta^A) A_{t-1}^i \right)$$

$$s \in \{M, H\}$$

All firms of the economy are owned by non liquidity constrained households who share the total profit of the final and intermediate sector firms, $\sum_{j=1}^{n} PR_{j,t}^{f,i}$ and $\sum_{j=1}^{A_t} PR_{j,t}^{x,i}$, where *n* and A_t denote the number of firms in the final and intermediate sector respectively. As shown by the budget constraints, all households pay t_t^w wage income taxes and t_t^K capital income taxes less tax credits (τ^K and τ^A) and depreciation allowances ($t_t^K \delta^K$ and $t_t^K \delta^A$) after their earnings on physical capital and patents.

The utility function is additively separable in consumption (C_t^i) and leisure ($1 - L_t^{i,s}$). We assume log-utility for consumption and allow for habit persistence.

(2a) $$U(C_t^i) = (1 - habc) \log\left(C_t^i - habc C_{t-1} \right).$$

For leisure we assume CES preferences with common labour supply elasticity but a skill specific weight (ω_s) on leisure. This is necessary in order to capture differences in employment levels across skill groups. Thus preferences for leisure are given by

(2b) $$V(1 - L_t^{i,s}) = \frac{\omega_s}{1 - \kappa} (1 - L_t^{i,s})^{1-\kappa}, \qquad \text{with } \kappa > 0 .$$

The investment decisions w.r.t. real capital and decisions w.r.t. the degree of capacity utilisation are subject to convex adjustment costs Γ_J and Γ_U, which are given by

(3a) $$\Gamma_J (J_t^i) = \frac{\gamma_K}{2} \frac{\left(J_t^i \right)^2}{K_{t-1}^i} + \frac{\gamma_I}{2} (\Delta J_t^i)^2 \quad \text{and}$$

(3b) $\Gamma_U(ucap_t^i) = a_1\left(ucap_t^i - ucap_t^{ss}\right) + a_2\left(ucap_t^i - ucap_t^{ss}\right)^2$,

where $ucap_t^{ss}$ is the steady state capacity utilisation.

Wages are also subject to convex adjustment costs given by

(4) $\Gamma_W(W_t^{i,s}) = \sum_s \frac{\gamma_W L_t^{i,s}}{2} \frac{\Delta W_t^{i,s\,2}}{W_{t-1}^{i,s}}$

1.2 Liquidity constrained households

Liquidity constrained households do not optimize but simply consume their current income at each date. Real consumption of household *k* is thus determined by the net wage income plus net transfers

(5)

$$(1+t_t^c)P_t^C C_t^k + \sum_s \frac{\gamma_W L_t^{k,s}}{2} \frac{\Delta W_t^{k,s\,2}}{W_{t-1}^{k,s}} = \sum_s \left(\left(1-t_t^{w,s}\right) W_t^{k,s} L_t^{k,s} + b_t^s W_t^{k,s}\left(1 - NPART_t^{k,s} - L_t^{k,s}\right)\right) + TR_t^k .$$

1.3 Wage setting

Within each skill group a variety of labour services are supplied which are imperfect substitutes to each other. Thus trade unions can charge a wage mark-up ($1/\eta_t^W$) over the reservation wage[30]. The reservation wage is given as the marginal utility of leisure divided by the corresponding marginal utility of consumption. The relevant net real wage to which the mark up adjusted reservation wage is equated is the gross wage adjusted for labour taxes, consumption taxes and unemployment benefits which act as a subsidy to leisure. Thus the wage equation is given as

(6) $\frac{U_{1-L,t}^{h,s}}{U_{C,t}^h} \frac{1}{\eta_t^W} = \frac{W_t^s(1-t_t^{w,s}-b_t^s)}{(1+t_t^C)P_t^C}$ for $h \in \{i,k\}$ and $s \in \{L,M,H\}$.

[30] The mark-up depends on the intratemporal elasticity of substitution between different types of labour σ_s and fluctuations in the mark-up arise because of wage adjustment costs and the fact that a fraction *(1-sfw)* of workers is indexing the growth rate of wages π^w to wage inflation in the previous period
$\eta_t^w = 1 - 1/\sigma_s - \gamma_W/\sigma_s \left[\beta(sfw\pi_{t+1}^w - (1-sfw)\pi_{t-1}^w) - \pi_t^w\right]$

2 Firms

2.1 Final goods production

The sector consists of n monopolistically competitive firms indexed by *j,* producing a variety of the domestic good which is an imperfect substitute for the varieties produced by other firms. Final output (Y^j) is produced using A varieties of intermediate inputs (x) with an elasticity of substitution θ. The final good sector uses a labour aggregate and domestic intermediate goods with Cobb-Douglas technology, subject to a fixed cost FC_Y and overhead labour FC_L

$$(7) \qquad Y^j = \left(A_t^{exog}\left(L_{Y,t}^j - FC_L\right)\right)^{\alpha}\left(\sum_{i=1}^{A_t}\left(x_{i,t}^j\right)^{\theta}\right)^{\frac{1-\alpha}{\theta}} - FC_Y, \;\; 0<\theta<1$$

with

$$(8) \qquad L_{Y,t} = \left(s_L^{\frac{1}{\sigma_L}}\left(ef_L L_t^L\right)^{\frac{\sigma_L-1}{\sigma_L}} + s_M^{\frac{1}{\sigma_L}}\left(ef_M L_t^M\right)^{\frac{\sigma_L-1}{\sigma_L}} + s_{H,Y}^{\frac{1}{\sigma_L}}\left(ef_H L_t^{HY}\right)^{\frac{\sigma_L-1}{\sigma_L}}\right)^{\frac{\sigma_L}{\sigma_L-1}}.$$

Parameter s_s is the population share of labour-force in subgroup s (low-, medium- and high-skilled), L^s denotes the employment rate of population s, ef_s is the corresponding efficiency unit, and σ_L is the elasticity of substitution between different labour types. Note that high-skilled labour in the final goods sector, L_t^{HY}, is the total high-skill employment minus the high-skilled labour working for the R&D sector ($L_{A,t}$). The employment aggregates L_t^s combine varieties of differentiated labour services supplied by individual household

$$(9)\; L_t^s = \left[\int_0^1 L_t^{s,h\,\frac{\sigma_S-1}{\sigma_S}}\,dh\right]^{\frac{\sigma_S}{\sigma_S-1}}$$

The parameter $\sigma_s > 1$ determines the degree of substitutability among different types of labour.

The objective of the firm is to maximise profits

$$(10)\; PR_t^{f,j} = P_t^j Y_t^j - \left(W_t^L L_t^{j,L} + W_t^M L_t^{j,M} + W_t^H L_t^{j,HY}\right) - \sum_{i=1}^{A_t}\left(px_{i,t}\, x_{i,t}^j\right),$$

where px is the price of intermediate inputs and W_t^s is a wage index corresponding to the CES aggregate $L_t^{j,s}$. All prices and wages are normalized with P_t, the price of domestic final goods. In a symmetric equilibrium, the demand for labour and intermediate inputs is given by

$$(11a) \quad \alpha\frac{Y_t + FC_Y}{L_{Y,t} - FC_L}\left(\frac{L_{Y,t}}{L_t^s}\right)^{\frac{1}{\sigma_L}} s_s^{\frac{1}{\sigma_L}} ef_s^{\frac{\sigma_L-1}{\sigma_L}} \eta_t = W_t^s, \quad s \in \{L, M, H\}$$

(11b) $$px_{i,t} = \eta_t (1-\alpha)\left(Y_t + FC_Y\right)\left(\sum_{i=1}^{A_t}\left(x_{i,t}^{j}\right)^{\theta}\right)^{-1}\left(x_{i,t}\right)^{\theta-1}$$

where $\eta_t = 1 - 1/\sigma_t^d$

2.2 Intermediate production

In the intermediate sector, firms are monopolistically competitive and enter the market by licensing a design from domestic households and by making an initial payment FC_A to overcome administrative entry barriers. Capital inputs are also rented from the household sector for a rental rate of i_t^K. Firms which have acquired a design can transform each unit of capital into a single unit of an intermediate input. Intermediate goods producing firms then sell their products to domestic final good producers.

Each domestic intermediate firm solves the following profit-maximisation problem

(12) $$PR_{i,t}^{x} = \max_{x_{i,t}}\left\{px_{i,t}x_{i,t} - i_t^K P_t^C k_{i,t} - i^A P_t^A - FC_A\right\}$$

subject to a linear technology which allows to transform one unit of effective capital ($k_i \cdot ucap_t$) into one unit of an intermediate good

(13) $$x_{i,t} = k_{i,t} \cdot ucap_t .$$

In a symmetric equilibrium the first order condition is

(14) $$\theta\eta_t (1-\alpha)\left(Y_t + FC_Y\right)\left(\sum_{i=1}^{A_t}\left(x_{i,t}^{j}\right)^{\theta}\right)^{-1}\left(x_t\right)^{\theta-1} = i_t^K P_t^C$$

2.3 R&D sector

The R&D sector hires high-skilled labour (L_A) and generates new designs according to the following knowledge production function:

(15) $$\Delta A_t = \nu A_{t-1}^{*\varpi} A_{t-1}^{\phi} L_{A,t}^{\lambda}$$

In this framework, innovation corresponds to the discovery of a new variety of producer durables that provides an alternative way of producing the final good. Parameters ϖ and ϕ measure the foreign and domestic spillover effects from the aggregate international and domestic stock of knowledge (A^* and A) respectively. Parameter ν can be interpreted as total factor efficiency of R&D production, while λ measures the elasticity of R&D production on the number of researchers (L_A). The R&D sector is operated by a research institute which employs high skilled labour at their market rate W^H. We also assume that the research institute faces an adjustment cost of hiring new employees and maximizes the following discounted profit-stream:

(16) $$\max_{L_{A,t}} \sum_{t=0}^{\infty} d_t \left(P_t^A \Delta A_t - W_t^H L_{A,t} - \frac{\gamma_A}{2} W_t^H \Delta L_{A,t}^2 \right)$$

Therefore the first order condition implies:

(17) $$\lambda P_t^A \frac{\Delta A_t}{L_{A,t}} = W_t^H + \gamma_A \left(W_t^H \Delta L_{A,t} - d_t W_{t+1}^H \Delta L_{A,t+1} \right)$$

where d_t is the discount factor.

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