CONSUMPTION RISK SHARING IN THE EUROPEAN MONETARY UNION AND CANDIDATE COUNTRIES

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MENTOR

READER

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Dedicated to:

My husband Philippe,

My wonderful boys Arthur and Paul,

My parents Valentina and Peter Zlatev

Thank you for your love, faith in me, inspiration, and support

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Chapter 1

INTRODUCTION

In 2004 ten countries are preparing to sign accession agreements with the European Union (EU): Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia. This step represents the culmination of several years of preparation and fulfillment of "synchronization" criteria, particularly economic and legal ones. Such conscientious effort on behalf of the candidates clearly states their belief in the advantageous effects of membership in the European economic and monetary union (EMU).

One of the potential benefits of participation in a monetary and financial union for the newcomers is increase in the level of consumption and income risk insurance. Complete consumption risk insurance should obtain theoretically in equilibrium when financial markets are complete or when there are institutions implementing optimal allocation. A country entering monetary union frees itself from exposure to disturbances originating in the LM sector and its exchange rate relations with the members of the union in return for yielding its independent monetary policy. Financial union, on the other hand, eliminates large cross-border variations in financial transaction fees and broadens the numbers and types of financial assets in the economy. Will participation in the EMU contribute to a higher degree of consumption and income risk insurance in the accession countries, as well as within the core EMU members? Will the new-comers benefit more than the core countries or vice versa?

This paper proposes to evaluate the potential contribution of a monetary union with regards to achieving fuller degree of consumption risk insurance. To do so, I will test the degree of consumption risk sharing among the candidates for the EU, and at a later stage to the EMU, as well as among the core countries. Specifically, this study will look at the following questions: First, is there consumption risk sharing among the EMU core countries and among the candidates? Second, if yes, what is the degree of risk sharing within the two groups, as well as between them? Last, what will the effect of joining single European monetary policy be on consumption risk sharing for the less economically advanced candidate countries, as well as for the core countries? To answer these questions, I conduct empirical tests following two models proposed by Canova and Ravn (1996), and Crucini (1999) respectively. Data was available for all core EMU countries, except Luxemburg (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain), and all candidates for 2004 accession to the EU, except Cyprus.

Analyzing the implications of the theory behind both models, I find that consumption risk sharing is present in both the EMU and CC groups of countries, but it is more prevalent and more consistent within the EMU group. Furthermore, I examine the interaction between the CC and EMU countries on the consumption and income plane and find evidence that both groups can gain from enlargement of the union in achieving more efficient and optimized risk-sharing. The findings presented in this paper can strengthen the evidence on consumption risk sharing in the existing literature.

My contribution to the literature is twofold, empirical and methodological. I conduct an empirical analysis of consumption risk sharing for the CC countries, for which I could not find a precedent in the existing literature. Similarly, I could not account for other works conducting empirical analysis of the EMU countries united by their status as EMU members, even though there are a number of studies examining some of these countries either as G-7 members or OECD members. From methodological point of view, I explored a new application of the model developed by Crucini (1999) by identifying cross-group interactions between a region and a country not belonging to that region.

Chapter 2

LITERATURE REVIEW

2.1 Monetary Union and Consumption Risk Insurance

A substantive body of literature has examined both theoretically and empirically the arguments for and against economic and monetary union. There is a wide spread agreement among economists that removal of trade barriers will contribute to specialization in the areas of comparative advantage and growth of the productive set of opportunities available to the economies, as predicted in Heckscher – Ohlin theorem (Salvatore 2001). The dispute, however, remains over the role of a monetary union in synchronization of business cycles within the member countries. Its validity is even greater on the brink of accession of new countries at different stages of economic development to the EU in 2004, and to the EMU possibly around 2007 (see Appendix 1 for EMU requirements).

One of the arguments in favor of monetary unification is the benefit of market integration and elimination of exchange rate uncertainties. Separate currencies pose significant barrier to commodity and factor-market integration. The presence of national currencies implies exchange rate uncertainty and this discourages cross-border transactions. Introduction of a common currency can, therefore, lead to substantive savings (Eichengreen 1993). Integration of segmented markets will allow monetary union constituents to specialize fully in producing goods and services in which they have comparative advantage. Monetary unification will also bring about the free flow of factors of production to wherever they have the highest return.

A common currency across all countries, such as the euro, can promote greater competition among producers. Salvatore (2002a) points out that the consumers will be able to compare across a wider geographic area and will seek to acquire the bundle of goods available at the lowest cost. This will eventually stimulate competition, benefit consumers and bring greater prosperity in the area as a whole.

Additional aspect of price stability and common currency according to Salvatore (2002a) is the commitment to greater economic discipline. Countries with history of high inflationary pressure, such as Greece and Portugal, succeeded in reducing their inflation dramatically. Same is true for Eastern European countries (EEC). For example, Poland suffered from hyperinflation in the 1990s and saw consumer prices rising by only 0.8% in 2002. In Estonia inflation rates dropped from 30% annual in 1996 to just 2.7% in 2002 (Economist 2003). It is beyond a doubt that the goal of EU accession and binding criteria imposed by the 1991 Maastricht Treaty have played decisive role in these countries' will to fight inflation and therefore secure price and wage stability for consumers.

Another significant contribution of an economic and monetary union is the complete elimination of capital controls and the ability of capital to flow freely to its most productive utilization. According to Eichengreen (1993), capital controls within the EU ranged form taxes on holdings of foreign currency assets to detailed regulations on the uses to which foreign currencies could be put. All of them represented obstacles to completing the internal market. Already Phase I of the three-phased Maastricht Treaty for European monetary integration envisaged the removal of capital controls across the EU.

Obstfeld (1989) examines a number of potential benefits attributable to capital market integration, such as the one observed for countries entering a monetary union. One important outcome of capital market integration is that it allows residents of various countries to pool different risks, achieving more effective consumption and income insurance than purely domestic arrangements would allow. Capital market integration also fosters economic growth. Obstfeld (1998) points out that there are historically documented growth benefits, particularly for smaller countries, e.g. Norway. Unobstructed access to capital is especially important to countries at a lower level of economic development, such as the new candidates for the EU. Developing countries with little capital can borrow to finance investment, thereby increasing domestic savings and national welfare.

Financial institutions can also become more efficient with cross-border capital market integration, thus offering a wider variety of financial products and completing the consumption insurance market. Berger, Deyoung, Hesna, and Udell (2000) investigate the consequences of consolidation of financial institutions across borders in terms of lowering and absorbing shocks. They find that there has been considerable cross-border consolidation of all types of financial institutions following the post-Maastricht deregulation of cross-border economic activity in both financial and non-finacial markets in Europe. For the securities and insurance industries, the market values of cross-border M&As have actually exceeded the values of within nation M&As in recent years. The authors conclude that such policy changes as the EMU will have important social consequences for systemic risk, the safety net and monetary policy, as well as for efficiency of the financial service industry.

Other benefits of the euro described by Salvatore (2002b) include seigniorage from the use of the euro as an international currency, the reduced cost of borrowing at international financial markets, as well as the increased economic and political importance the EU will acquire in international affairs.

Experiencing the benefits of a monetary union comes also at a cost. The most important sacrifice of countries joining a monetary union is the loss of independent monetary policy coupled with limited freedom for maneuvering with fiscal policy instruments. Eichengreen (1993) calls the tradeoff between controlling either interest rates or exchange rates "inconsistent trinity". That is, a country cannot simultaneously maintain fixed exchange rates and an open capital market while pursuing a monetary policy oriented toward domestic goals. Governments may choose only two of the above.

The "inconsistent trinity" is in the heart of the argument for the ability of monetary union to serve adequately to the needs of all its members. Exploring the theory of optimum currency areas, Mundell (1961) suggests that the reduction in transaction costs associated with a common currency should be balanced against the benefits of retaining monetary independence and exchange rate changes as instruments of adjustment. Specifically, members of the EMU are subjected to the uniform monetary policy of the European Central Bank (ECB) regardless of the prevailing economic situation within each nation. ECB's reaction to a shock will be less likely to affect adversely one nation while trying to stabilize another if the shock affects all countries in a similar way. A prerequisite for such optimum outcome is synchronization of the business cycles of member states. The literature on monetary union is divided on whether it contributes to increase or decrease in business cycle synchronization.

On one side, authors like Krugman (1993), Eichengreen (1993), and Mundell (1961) argue that lower barriers to trade will induce countries to specialize more, which in turn will produce less symmetric output fluctuations. This interpretation will eventually render EMU unable to respond efficiently to shocks, since different members are undergoing different economic fluctuations. Eichengreen points out that temporary disturbances attributable to demand-management policy are likely to become more symmetric following EMU, while permanent or supply disturbances will have less tendency to change.

Frankel and Rose (1998), on the other hand, claim that the removal of trade barriers will entail more correlated business cycles, since a higher level of trade will allow demand shocks to spread more easily across national borders. They further mention that economic integration will contribute to greater correlation of policy shocks and that knowledge and technology spillovers will increase.

Since the debate for desirability of economic integration centers on the degree of symmetry of macroeconomic fluctuations across countries, it is important to find out what is the degree of consumption risk insurance against such fluctuations within the already existing EMU. The answer to this question will shed some light on the issue whether new-coming members will increase or decrease their level of consumption and income risk insurance.

2.2 Consumption Risk Sharing

Insuring income and consumption from uncertainty has been modeled from various perspectives, including the New Open Economies Macroeconomics (NOEM), domestic and international financial markets setup, monetary union perspective, growth and development literature, and production specialization.

NOEM

NOEM literature attempts to lay classic macroeconomic issues on micro foundations simultaneously incorporating recent developments in the area of international finance. A special emphasis within NOEM is placed on the implications of expanding global markets for securities and derivatives, and consequently their role in risk insurance. Maurice Obstfeld and Kenneth Rogoff (1996) develop NOEM model where economies in autarky are deprived from the opportunities for trade, investment and production diversification available to economies with open goods and assets markets. Specifically, chapter 5 proposes a two-date model of economies trading financial assets with uncertain return in an environment of unexpected output, government spending and productivity shocks. By trading risky foreign assets countries are able to achieve better consumption and income risk insurance compared to a riskless bond-only trade. The analysis builds upon the classic model of complete contingent claims markets developed by Kenneth Arrow (1964) and Gerard Debreu (1959). The idea is that people often have sufficient foresight to make asset trades that protect them, at least partially, against future contingencies. These assets have uncertain payoff themselves but tend to have unexpectedly high returns when the individual has very bad economic luck elsewhere (e.g. health, disability, or auto insurance). Currencies, stocks, long-term bonds and their derivatives can also play an insurance role.

International trade in risky assets versus bonds-only trade can dramatically alter the way an economy's consumption, investment and current account respond to unanticipated shocks. This can be illustrated with a small endowment economy where a representative individual places a 100% of his output risk in international markets (e.g. by selling off local industries to foreign investors and purchasing an insurance policy that guarantees an income level). Then a shock to the country's GDP does not affect the GNP. The increase in domestic output is matched exactly by a lower net inflow of asset income from abroad. Neither income consumption, nor the current account change. The presence of international markets for risky assets weakens the link between shocks to a country's output and shock's to its residents' income and consumption.

Monetary Union

Salvatore (2001) describes monetary union as the highest level of economic integration among nation states. This characteristic makes it a natural environment for examination of models of risk spreading and diversification across countries. A model where a monetary union is desirable to enhance consumption and income risk insurance if the gains exceed the costs is proposed by Pablo Neumeyer (1998). Unlike Obstfeld and Rogoff, Neumeyer offers a more realistic setup with incomplete asset markets and examines how a monetary union affects the efficiency of risk allocation in the economy. It is shown that the adoption of monetary union involves a trade-off between the benefits of reducing "excessive" exchange rate risk and the costs of reducing the number of assets in the economy. Currency unions and permanently fixed exchange rate regimes can be viewed as monetary rules that attempt to improve welfare by insulating money from domestic politics. The adoption of a fixed exchange rate regime, on the other hand, also has costs. When fluctuations in the value of money reflect economic shocks, some exchange rate variability is "good" because, by making the real payoffs of nominal assets denominated in real currencies distinct, it increases the insurance opportunities available through trade in nominal assets. The loss of monetary independence is socially costly because it reduces the number of financial instruments with which economic agents can share risks.

In this model there are two types of shocks: economic and political. The economic uncertainty is associated with the realization of each individual's income (state of nature). When asset markets are complete, there is perfect risk sharing, or full insurance. With incomplete financial markets, equilibrium portfolio is the one that minimizes excess demand. The model predicts that gains form a monetary union, fixed exchange rate, and independent central bank are higher in countries where exchange rate volatility arises from political shocks. Monetary instability is socially costly because tampering with nominal financial contracts has negative effects on financial markets. If, however, the countries considering a monetary union experience similar economic shocks, have independent central bank, and there are good risk-sharing devices within the countries but not across international borders, currency union might be Pareto inferior. It will entail the elimination of U currencies, and thus reduce the number of assets available in the economy making the complete markets allocation not feasible.

Another author who examines risk insurance aspects of a monetary union is George von Furstenberg (2002). He looks at the welfare gains from income and consumption insurance within the framework of complete financial markets. Von

Furstenberg finds these gains much larger than the ones available from access to non-contingent international borrowing among members of a monetary union. While insurance tackles asymmetric, and hence non-diversifiable risks, the single monetary policy seeks to cushion symmetric disturbances that have an effect on the union as a whole. The author argues that deep monetary and financial integration eventually facilitates a much higher degree of consumption insurance through a variety of formal and informal insurance channels than would be available to members in the absence of monetary union.

Using a fully optimized numerical demonstration von Furstenberg shows that the welfare effects of completing the internal market for contingencies through a monetary union are likely to be much larger than the mere introduction of perfect capital mobility. (The later is defined as unrestricted access to borrowing at interest rates that are equalized throughout the area.) Building his analysis upon Obstfeld and Rogoff's NOEM model, von Furstenberg's calibration shows that for certain parameter values there are relatively small gains in utility from optimal international borrowing (riskless assets market). The utility gains are much higher, however, when the international market for contingent claims is complete. Another interesting result is that the stable country or monetary union gains much more than the unstable country outside the union. Unlike the outsider, the core of the monetary union does not have much use for insurance except as a highly profitable business since its prospects for date 2 are certain. The foreign country's prospects for date 2 are on balance more favorable but highly uncertain, so this country has to accept insurance prices that are actuarially unfair. The conclusion is that monetary union with countries of far les certain prospects clearly is most advantageous for the insurance business of the stable core countries if monetary union is the key to more complete financial markets in the union.

Production

Production uncertainties have also prompted economists to examine various risk insurance setups. Harold Cole (1988) looks at consumption and income risk sharing when the available opportunities are jointly determined by the types of financial markets and the production possibilities of the economy. Cole analyzes the effects of changes in the variety and degree of completeness of the financial assets upon the variance and covariance of key real variables such as consumption, output, and trade balance.

Cole proposes a two country, two period model of international trade where labor is the only production input, and output is subject to random production shocks. This production structure generates random uncertainty regarding agents' income and an incentive for them to engage in consumption smoothing and risk sharing. He then examines the behavior of the endogenous variables under three different systems of financial intermediation. The first and most primitive involves only ex-post securities (securities that are traded only after the resolution of uncertainty and are therefore not state contingent). The ex-post securities enable agents to specialize in production according to their comparative advantage and to separate their production and consumption decisions. The second structure is the most sophisticated and involves complete Arrow securities. This structure shows the optimum degree of insurance agents can obtain given the restrictions on the production structure. The third case is an intermediate between the firsts two in which the agents are constrained as to the type of securities they can purchase prior to the resolution of the uncertainty. They are only able to trade residual claim (or equity) securities in the ex-ante securities market.

Cole reasons that as financial markets become more complete, agents are better able to diversify the risks associated with changes in their own production shocks. However, it also increases the degree to which changes in the other country's production shocks have a direct effect upon the agent's wealth. The model predicts that as financial markets become more complete, the variability of consumption decreases, the covariance between domestic and foreign consumption increases, and the variability of output increases.

Kalemi-Ozcan, Sorensen, and Yosha (2000) take a different approach to examining the relationship between risk sharing and the productive set of opportunities in the economy. They analyze how the diversification of production risk via capital markets stimulates greater specialization in production. In the presence of production risk and in the absence of markets for insuring this risk, countries that specialize in the production of a small number of goods may suffer a loss in economic welfare due to the high variance of GDP. Kalemi-Ozcan et al. exploit the proposition that if inter-regional and international capital markets are well integrated, regions and countries, begin insured against idiosyncratic shocks, can afford to specialize more. The proposition that countries gain from specialization is one of the few widely accepted economic tenets.

Their empirical test proceeds first with construction of a measure of specialization in production and then calculation of an index of specialization for each of the countries and regions in their sample. Then they estimate the degree of capital market integration – a measure of risk sharing – within each of the groups of regions. Finally, they perform a regression of the specialization index on the degree of risk sharing. They find that risk sharing, facilitated by a favorable legal environment and developed financial system, is direct determinant of industrial specialization.

Economic growth

Consumption and income risk sharing reflect on economic growth. Maurice Obstfeld (1994) examines a model of global portfolio diversification, which links growth and financial openness. Within the model, an economy that opens its asset markets to trade may experience an increase in expected consumption growth and a substantial rise in national welfare. The mechanism linking global diversification to growth is the world portfolio shift from safe but low yield capital into riskier high-yield capital. Since riskier assets have higher return than safer ones, international asset trade, which allows each country to hold a globally diversified portfolio of risky investments, encourages all countries simultaneously to shift from low return safe investment to high return risky investment. Provided risky returns are imperfectly correlated across countries, and provided some risk free assets are initially held, a small rise in diversification opportunities always raises expected growth as well as national welfare.

The model supposes that each country can invest in two linear projects, one safe and one risky. The presence of these two types of capital captures the idea that growth depends on the availability of an ever-increasing array of specialized, hence inherently risky, production inputs. Obstfeld uses Epstein and Zin (1989) utility preferences which allow for separate coefficients for intertemporal substitution and risk aversion. The optimality conditions state that consumption behavior depends on attitudes toward intertemporal substitution as well as toward risk, whereas portfolio choice depends only on risk aversion. Calibration exercises using consumption data and stock market data (annual stock market return and standard deviation) imply that most countries reap large steady-state welfare gains from global financial integration.

Michael Devereux and Gregor Smith (1994) take a different view than Obstfeld (1994) on the effects of international risk sharing on growth. They specify a model where countries face income risk but there is no aggregate uncertainty at the world level. With constant relative risk aversion in preferences riskier income leads to greater savings. With full risk sharing, income risk is diversified away, reducing the equilibrium savings rate in each country. Lower savings, in turn, lead to lowering the growth rate in each country. Their findings are that growth rates in all countries are lower in the equilibrium with full diversification. In addition, the welfare of each country may be lower than in an equilibrium without risk sharing. The authors conjecture that a partial diversification, as opposed to complete one, will also reduce growth and may reduce welfare. Devereux and Smith notice though that if instead of looking at income risk we look at a distribution of productivity disturbances, then financial market integration always raises welfare.

Empirical tests on consumption risk sharing

There is a growing body of empirical literature examining the degree of consumption risk sharing occurring at provincial, bilateral and regional levels. Fabio Canova and Morten Ravn take the traditional approach testing the null hypothesis of full consumption risk insurance. In "*International Consumption Risk Sharing*"(1996) they examine the implications of international consumption risk sharing for a panel of nine

OECD countries. The basic idea of consumption insurance is the cross-sectional counterpart of the permanent income hypothesis. With complete insurance consumption of the individual units (agents, families or countries) should not vary in response to idiosyncratic income shocks, while if the permanent income hypothesis holds consumption should not vary in response to transitory shocks. Full consumption insurance obtains in a competitive equilibrium when financial markets are complete or when there are institutions implementing optimal allocations. Their results state that aggregate domestic consumption is almost completely insured against idiosyncratic real demographic, fiscal and monetary shocks over short cycles, but that it covaries with these variables over medium and long cycles.

Marco Crucini's article *"On International and National Dimension of Risk Sharing"*(1999) tests the implications of risk sharing across regions and countries. Instead of taking the traditional approach of testing the null hypothesis of full consumption risk sharing in panels of regional and national data, he tests the extent of consumption risk sharing and how does it differ among regions and countries. Crucini recognizes that risk-sharing theory produces full consumption insurance only under stringent assumptions, e.g. that contracts can be written and enforced at zero cost. Also given that the costs and benefits of risk sharing may differ across individuals and across different contingencies, individuals will choose different levels of risk sharing. One should expect then that risk sharing may be imperfect and should rather conduct a test then on the degree of consumption risk sharing.

Crucini proposes an estimation method that produces a parameter λ measuring the fraction of an individual income stream exchanged for a claim to the pooled income streams of all agents. Thus average individual income is composed from the share coming from the total stream of pooled income at national or regional level (λ) and the share coming from other income not associated with risk pooling (1- λ). The parameter λ is interpreted as the extent of consumption risk sharing. The sample includes provinces of Canada, states of the United States and the G-7 countries. Crucini finds similar degree of risk sharing within regions of Canada and the U.S. that exceeds the risk sharing occurring across countries.

Another approach to empirically test for consumption and income risk sharing is to quantify the welfare gains occurring in the presence of such process, or alternatively the welfare loss experienced by closed economies. There are two common measures of welfare changes due to risk sharing: one is based on changes in consumption and the other is based upon stock returns.

Karen Lewis (2000) observes that estimates of the gains to international risk-sharing based upon stock returns tend to find dramatically higher gains than do estimations from consumption-based models. Calculations based upon international consumption data suggest that welfare gains from risk sharing are quite small – gains are often in the magnitude of 0.5% of permanent consumption. Calculations of welfare gains in risk sharing using stock returns, however, tend to show much larger estimates. This approach typically constructs combinations of domestic and foreign portfolios that minimize variance and maximize returns and asks whether domestic portfolios are dominated by these portfolios. A number of empirical studies have shown that portfolios with foreign stock strictly dominate domestic only portfolios with welfare gains ranging between 20% and 100% of permanent consumption.

Lewis finds explanation of these differences in the following three arguments. First, stock returns are treated as exogenous rather than endogenous, while consumption is endogenous. The equity-based approach does not incorporate the effect of risk sharing on the stock price, while the consumption based approach does by asking how optimal risk-sharing would affect the consumption path. The second argument reflects the fact that gains from risk sharing depend crucially upon the benefits of reducing the variability of marginal utility over time. The difference then arises from the greater variability of stock returns relative to consumption. Finally, the different sets of preference parameters used in the two approaches also bring about results with larger differences.

Yet another type of estimation of risk-sharing is proposed by Asdrubali, Sorensen, and Yosha (1996). They propose a framework which quantifies the amount of risk sharing among states in the U.S. The channels of risk sharing in a federal regime identified here are: 1) capital markets which facilitate risk diversification via the cross-ownership of productive assets; 2) the tax-transfer system of the federation's central government; and 3) credit markets which allow income and consumption smoothing via lending and borrowing.

Their methodology centers on the decomposition of the cross-sectional variance of gross state product and yields the following relationship: $1 = \beta_K + \beta_F + \beta_C + \beta_U$ where β_K, β_F, and β_C are the fractions of shocks to gross state product smoothed via capital markets, by the federal system, and via credit markets, and β_U is the fraction not smoothed. They find that 39% of shocks to gross state product are smoothed by capital markets, 13% are smoothed by federal government, and 23% are smoothed by credit markets. The remaining 25% are not smoothed.

Chapter 3

CONSUMPTION RISK SHARING WITHIN THE EUROPEAN MONETARY UNION AND CANDIADTE COUNTRY REGIONS

To examine the effects of a monetary union on consumption risk sharing, I develop a model following Obstfeld and Rogoff (1996) and Canova and Ravn (1996).

3.1 Model

This part of the paper proposes a general framework establishing consumption sharing among pairs of countries. The hypothesis of interest is whether consumption risk sharing exists within the two regions - European Monetary Union (EMU) and the Candidate Countries (CC) countries' region - versus the alternative that there is no consumption risk sharing. Looking at the theoretical assumptions regarding the advantageous impact of economic and monetary union on consumption risk sharing, one would expect that while both groups will have some degree of consumption risk insurance, the EMU countries will have a higher and more consistent level of consumption insurance compared to CC countries.

The general set up of a consumption risk sharing model is often a two-period model where in the first period the representative individual has an endowment or a known income Y_1, but has uncertain output on date 2 when two different states of nature s= 1,2 can occur. The prior probability of event occurring is π (s_t) and $\Sigma\ \pi(s_t) = s_1 + s_2 = 1$. An individual with uncertain income cannot predict his future optimal consumption exactly, not knowing which state of nature s will occur. The best (s)he can do is have a set of contingency plans for consumption by purchasing (or selling) contingent Arrow-Debreu assets at a price $p(s)/(1+r)$ which is exogenously given at the world market from a stand point of a small country. Let $B_2(s)$ denote the representative individual's net purchase of state s Arrow-Debreu securities on date 1, and r the world's riskless real rate of interest. With these actions, at date 1 the individual maximizes his expected lifetime utility which is the average utility given the chosen contingency plans for future consumption:

$$U_1 = U(C_1) + \pi_{(1)}\beta U[C_2(1)] + \pi_{(2)}\beta U[C_2(2)] \qquad (1)$$

This process is subjected to a constraint stating that the value of the country's net accumulation of assets on date 1 must equal the difference between its income and consumption.

$$\frac{p(1)}{1+r}B_2(1) + \frac{p(2)}{1+r}B_2(2) = Y_1 - C_1 \qquad (2)$$

When date 2 arrives, the state of nature s is observed, and the country will be able to consume the sum of its endowments and any payments on its state s contingent assets.

$$C_2(s) = Y_2(s) + B_2(s) \qquad s = 1,2 \qquad (3)$$

The intertemporal budget constraint is:

$$C_1 + \frac{p(1)\,C_2(1) + p(2)\,C_2(2)}{1+r} = Y_1 + \frac{p(1)\,Y_2(1) + p(2)\,Y_2(2)}{1+r} \qquad (4)$$

Then the intertemporal Euler equation is:

$$\frac{p(s)}{1+r}u'(C_1) = \pi(s)\beta u'[C_2(s)] \qquad (5)$$

The left-hand side of (5) is the cost, in terms of date 1 marginal utility, of acquiring a contingent financial asset for state *s*. The right-hand side of the equation is the expected discounted benefit from having an additional unit of consumption in state s on date 2.

One can use eq. (5) to derive the bond Euler equation. A riskless bond pays (1+r) output units on date 2 for every one output unit worth of bonds bought on date 1, equivalently: p(1) + p(2) = 1. Then the stochastic Euler equation for riskless bonds is:

$$u'(C_1)=(1+r)\pi(s)\beta u'[C_2(s)] \qquad (6)$$

We can extend this model to a continuous, multi-country, multi-state model. There are J countries in the world, j = 1,2 ..., J with preferences defined over homogeneous aggregate nondurable consumption good. The realization of state of nature at time t is s = 1,2...S<∞. The ex-ante probability at time t=1 of a particular historic realization is $\pi(s_t)$ and $\Sigma\,\pi(s_t)=1$. Each country is endowed with an exogenous stochastic amount $y_t(s_t)$ of the good or the economy's output at each time period *t*. Let $p(s)/(1+r)$ denote the world price of an Arrow-Debreu security which claims 1 output unit if state *s* occurs and 0 otherwise. Without imposing any restrictions, we can assume there is a competitive market for Arrow –Debreu security for every state of nature s. The planner computes optimal allocation of consumption goods by maximizing utility over future contingency plans:

$$\text{Max } U = U(C^j{}_1) + \sum_{t=2}^{\infty}\beta^{t-1}\left\{\sum_{s_t}^{S}\pi(s_t)U[C^j(s_t)]\right\} \qquad (7)$$

The budget constraint, a multiperiod version of (4), is given by:

$$(C^j{}_1) + \sum_{t=2}^{\infty}(R_{1,t})^{-1}\left[\sum_{s^t}^{S} p(s_t)C^j(s_t)\right] = (Y^j{}_1) + \sum_{t=2}^{\infty}(R_{1,t})^{-1}\left[\sum_{s^t}^{S} p(s_t)Y^j(s_t)\right] \tag{8}$$

Where $(R_{1,t})^{-1} = \dfrac{1}{1+r} = E_t\left\{\dfrac{\beta\, U'(C_{t+1})}{U'C_t}\right\}$ (9)

To optimize the model I use a Lagrangean multiplier:

$$L = U(C^j{}_1) + \sum_{t=2}^{\infty}\beta^{t-1}\left\{\sum_{s_t}^{S}\pi(s_t)U[C^j(s_t)]\right\} \tag{10}$$

$$+ \sum_{t=1}^{\infty}\gamma_t\left|\,(Y^j{}_1) + \sum_{t=2}^{\infty}R^{-1}{}_{1,t}\left[\sum_{s^t}^{S} p(s_t)Y^j(s_t)\right] - (C^j{}_1) - \sum_{t=2}^{\infty}R^{-1}{}_{1,t}\left[\sum_{s^t}^{S} p(s_t)C^j(s_t)\right]\right|$$

And the resulting first order conditions are:

$$\frac{\partial L}{\partial C_1} = U'(C^j{}_1) - \gamma_t = 0 \qquad \text{or} \qquad \gamma_t = U'(C^j{}_1) \tag{11a}$$

$$\frac{\partial L}{\partial C(s_t)} = \beta^{t-1}\sum_{s_t}\pi(s_t)U'[C^j(s_t)] - \gamma_t R^{-1}{}_{1,t}\,p(s)_t = 0 \tag{11b}$$

$$U'(C^j{}_1)\, R^{-1}{}_{1,t}\, p(s_t) = \beta^{t-1}\, E\, \Sigma\, \{\pi(s_t)\, U'[C^j(s_t)]\} \tag{11c}$$

The intertemporal Euler equation (11c) is generalized version of eq. (5) in the two-country, two-period model above. The left hand side is the cost in terms of marginal utility at date 1 of acquiring Arrow-Debreu security for state *s*. The RHS is the expected discounted benefit from having an additional unit of consumption in states *s* at date *t*. This is the optimality condition for the planner problem.

Instead of risky security, assume riskless bond which pays (1+r) units of consumption good in every state of nature s. Similar to eq. (6), with $\Sigma\, p(s_t) = 1$, the Euler eq. (11c) becomes:

$$U'(C^j{}_1)\frac{R_{1,t}}{\beta^t \pi_s} = U'[C^j(s_t)] \tag{12}$$

We can now replace the first expression on the LHS of (12) with γ_t, the Lagrangean multiplier for the resource constraint from eq. (11a) :

$$\gamma_t \frac{R_{1,t}}{\beta^t \pi_s} = U'[C^j(s_t)] \tag{13}$$

Denote the LHS of (13) $\gamma_t \frac{R_{1,t}}{\beta^t \pi_s} = \mu$ and multiply the RHS by time and state invariant weights $\Phi = \psi / \chi$ related to the initial wealth of each country ψ and the size of the country χ. We assume that along the equilibrium path the planner does not reallocate wealth and that the size of the country in terms of population does not change.

$$\mu_t = U'[C^j(s_t)].\Phi \tag{14}$$

Equation (14) implies that, apart from a scale factor, the marginal utility of consumption is equalized across countries (γ_t is the same for all countries' FOC; R_t, real rate of return, is equalized across countries with open financial markets). We can use (14) and the fact that μ_t is independent of j to derive the following conditions which must be true for any pair of j, k $\in$ J: for country j, $\mu_t = U^j{}_{c_t}\Phi_j$, and for country k, $\mu_t = U^k{}_{c_t}\Phi_k$, or equating the LHS:

$$U^j{}_{c_t}\Phi_j = U^k{}_{c_t}\Phi_k$$

Taking logs:

$$\log U^j{}_c - \log U^k{}_c = \xi_{j,k} \qquad \text{with } \xi_{j,k} = (\log \Phi_k - \log \Phi_j) \tag{15}$$

$$\log U^j{}_c - \log U^a{}_c == \psi_{aj} \qquad \text{with } \psi_{aj} = \log \Phi_a - \log \Phi_j \tag{16}$$

where $U^a{}_c = 1/J\ \Sigma_{j=1}\ U^j{}_c$ is the average marginal utility of the group of countries, and $\Phi_a = 1/J\ \Sigma_{j=1}\ \Phi_j$ is the average of the time invariant weights of the group of countries. The RHS of (15) and (16) are independent of the date and the state. Both (15) and (16) impose strong restrictions on the data because they equate the marginal utility of consumption for any pair of countries j,k and for all histories and dates. Because c_t is not observable for all histories and dates, for the purpose of the empirical test I will use weaker restrictions based on the moments of the logarithm of the marginal utility of consumption:

$$E\{\log U^j_c\} = E\{\log U^k_c\} - \xi \qquad (17)$$

$$\mathrm{var}\{\log U^j_c\} = \mathrm{var}\{\log U^k_c\} \qquad (18)$$

$$\mathrm{cov}\{\log U^j_c, \log U^j_c\} = \mathrm{cov}\{\log U^j_c, \log U^k_c\} \qquad (19)$$

Most empirical tests on consumption risk sharing use a Constant Relative Risk Aversion (CRRA) utility function. This utility function assumes that the coefficient of relative risk aversion is the same as the inverse of the intertemporal elasticity of substitution. Obstfeld (1994) and Lewis (2000) use Epstein and Zin utility function which allows for two separate parameters, one gauging relative risk aversion and the other the intertemporal elasiticity of substitution. I will use the standard CRRA utility function following Canova and Ravn (1996), Crucini and Hess (1999), and Hansen and Singleton (1982):

$$U(c^j_t) = \frac{1}{1-\sigma}\left[(c^j_t)^{1-\sigma} - 1\right] \; if \sigma_j \neq 1 \forall j \qquad (20)$$

$$U(c^j_t) = \log(c^j_t) \text{ otherwise} \qquad (21)$$

Using (20) and (21) to substitute in the moment conditions (17)-(19) the following testable moments are formed:

$$X_{1,t} = \log c^j_t - \left(\frac{\sigma_k}{\sigma_j}\right)\log c^k_t + \xi \qquad (22)$$

$$X_{2,t} = (\log c^j_t)^2 - \left(\frac{\sigma_k}{\sigma_j}\right)^2 (\log c^k_t)^2 \tag{23}$$

$$X_{3,t} = \left(\sqrt{(\log c^j)^2 (\log c^k)^2}\right)^{-1} - \left(\frac{\sigma_k}{\sigma_j}\right) corr\,(\log c^j, \log c^k)(\log c^j)^{-2\,*} \tag{24}$$

If we define $X_t = [X_{1t}, X_{2t}, X_{3t}]'$, the first testable application of the theory is that X_t should be unpredicatable for a set of instrumental variables Z_t belonging to the information set available at *t* or $E_t [X_t \mid Z_t] = 0$. This would imply that there are no statistically significant differences in the change of consumption patterns across countries that can be predicted by the selected instruments. Canova and Ravn propose as instruments lagged values of income, prices and population.

The second testable implication is that the cross-equation constraints of (22)–(24) hold. This implies that the transformation of the slope coefficients of the three moment conditions equals the ratio of the coefficients of the relative risk aversion of the representative agents of the two countries.

Estimation of the above moment conditions will proceed with generalized method of moments (GMM) methodology, as proposed by Hansen and Singleton (1982), Kollmann(1995), and Canova and Ravn (1996). To check the unpredictability of X_t, I will use a J-test to examine whether the coefficients of a regression of X_t on the instruments are all zero. To tests the validity of the cross-equation restrictions, I will take restricted GMM estimates of the slope coefficients of the three moment conditions and test the cross-equation restrictions with a Wald test.

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* See Appendix 3 for explanation of my modifications to the moment condition (24) originally presented by Canova and Ravn (1996) p.579.

3.2 Data

Data was obtained from the International Financial Statistics (IFS) July 2003 for all countries except Greece and Ireland where quarterly data was unavailable and the respective Central Bank of each country was used as a data source. Official exchange rate of national currency per US dollar is line ..AE of the IFS; Official exchange rate Euro per US dollar – line 163..AE; Consumer Price Index – line 64; Private Consumption –line 96f.czf (local currency) and 96f.czw (euros); Gross Domestic Product – line 99b.czf (local currency) and 99b.czw (euros); Population (annual) – line 99z.

Data on EMU countries is for the period 1993Q1 until 2002Q4 or 40 observations, where after 1998Q4 data is given in Euros. Data points on Greece are for 1995Q1-2002Q4 or 34 observations and on Ireland are for 1997Q1-2002Q4 or 28 observations. Data on CC countries is for the same period, 1993Q1-2002Q4, with 31 observations for Hungary and Poland, and 28 observations for Slovenia.

For this model data on consumption and income are in national currency. Consumption is natural logarithm of total real aggregate consumption per capita (consumption /population), quarterly data, in real terms. Because data on population is annual, quarterly data are obtained by taking the predicted values of an AR (3) regression fitted to a dummy quarterly series, constructed assigning the annual value to each of the four quarters. Income data measure GDP in current national currency prices transformed in real terms using the national Consumer Price Index (CPI) for each country. GDP is quarterly, national currency, real terms. To convert currency data from euro in national currency for the EMU countries after 1999 I use the latest available exchange rate from Q4 1998.

3.3 Unit root tests

Kollmann (1995) suggests that logged consumption will probably follow a unit root process. From the set of instruments, income, measured by GDP, and prices, measured by CPI, are expected also to be nonstationary. Canova and Ravn propose three different detrending procedures to make the time series data stationary, since each of the procedures may affect differently the estimation process and therefore the conclusions. The methods used are linear detrending (LT), Hodrick and Prescott filtering (HP), and first order differencing (FOD). These methods leave stationary cycles in the data with a periodicity of less than 3 years for FOD, between 4 to 6 years for HP and 7 to 10 years for LT.

I conducted a unit root test on consumption (C), GDP (Y) and prices (S) using Augmented Dickey-Fuller (ADF) test for Austria, France and Germany from the EMU group, and Czech Republic, Hungary and Poland from the CC group. Variables are in real terms and have been transformed in logarithms. Since the model calls for three different procedures to induce stationarity – FOD, HP, and LT – I performed ADF tests for all three methods. The test has four lags to capture better the data variation over the four quarters. Appendix 2 shows the results for France and the Czech Republic only since the variables for the other countries have quite similar results.

The ADF tests demonstrate that while in majority cases log consumption, income and prices fail to reject the null hypothesis of unit root (p-values > 0.05 in the 4th column), FOD and HP makes these variables stationary (p-values < 0.05 in the last column). When LT is used as a detrending procedure, the results are mixed. Unit root continues to be present in some cases, especially for the CPI variables of all countries.

For the empirical estimation I apply the same detrending method to both consumption variables and instrumental variables. For example, if consumption is detrended linearly, the instruments are detrended linearly as well.

3.4 Empirical Results

To test the hypothesis of complete consumption risk-sharing between pairs of countries within the EMU, as well as within the CC region, I use the model identified in (22)-(24). Failure to reject the model implies that the pair of countries has achieved full consumption risk insurance under the model's assumptions. Estimation of the three moment conditions proceeds with GMM.

I consider a χ^2 test of the over-identifying restrictions, also known as Hansen's ***J*** test. Hansen (1982, p. 1049) and Hansen and Singelton (1982, p.1275) propose testing whether the over-identifying restrictions or the model holds using a J-test:

$$J_T = g_t(b)' W_T g_t(b)$$

$$J_T \rightarrow d\, \chi^2_{r-q}$$

where $g_t(b)$ is an expression for the sample orthogonality conditions evaluated at the parameter estimator b, W_T is an r by r weighting matrix, r is the number of orthogonality conditions and q is the number of parameters. Under the null hypothesis of complete risk sharing $E[X_t \mid Z_t] = 0$, changes in consumption for any pair of countries j, k is unpredictable for the set of instrumental variables Z_t. Therefore, the ***J*** test statistic has an asymptotic χ^2 distribution. Under the alternative hypothesis of incomplete risk sharing, the changes in the moment conditions will be correlated with the instrumental variables.

Hence the J test statistic will tend to be large. The other test I use is a Wald test for the cross-equation restrictions.

The test results for the orthogonality conditions of the first model are presented as follows: tables 1–3 and 4-6 report unrestricted GMM estimates respectively for EMU and CC countries; tables A4-A6 and A7-A9 in Appendix 4 report restricted GMM estimates for EMU and CC countries respectively. As instruments I used a constant, one and two lags of domestic output, domestic population and domestic prices. When considering a pair of countries, e.g. France-Germany, I use as instruments a constant, lagged French GDP, prices and population. Canova and Ravn suggest using only lagged values of the instruments in order to minimize endogeniety problems, which are present with output data, and measurement problems, which may arise when the measurement error in the instruments is contemporaneously correlated with the measurement error in consumption.

Estimation of equations (22)-(24) was conducted in SAS and the value of interest on the SAS output is Objective N* which follows the χ^2 distribution. The first row in each small table reports χ^2, the second row reports p-values in parenthesis. P-values in excess of 0.05 indicate failure to reject the null hypothesis using χ^2 test at 95%. The χ^2 critical value for 17 degrees of freedom (3 moments x 7 instruments – 4 parameters) is 27.59. Tables 1 and 3 report results form unrestricted GMM estimation for the EMU and CC countries respectively using FOD transformed variables. Similarly, tables 2 and 4 report results for HP detrended data, while tables 3 and 6 show results for LT detrended data.

The results from the *unrestricted GMM estimation* indicate that in overwhelming number of cases the null hypothesis of complete consumption risk insurance cannot be rejected for either EMU or CC country pairs. Within the EMU group of countries the three orthogonality conditions are never rejected for short cycles (FOD detrended data) and medium cycles (HD detrended data). Rejections in the unrestricted case can be seen only for long cycles (LT detrended data). This finding lends support to the hypothesis that consumption risk sharing is present in both short- and longer-term periods across countries having closer economic, financial, and geographic ties, such as the members of the EMU.

Table 1 Unrestricted GMM FOD Results for EMU Countries, $H_0: E\,[X \mid Z] = 0$

	Belgium	Finland	France	Germany	Greece	Italy	Ireland	Netherlands	Portugal	Spain
Austria	19.20 (0.32)	19.77 (0.33)	16.40 (0.78)	16.08 (0.48)	15.59 (0.58)	18.53 (0.37)	13.6 (0.70)	10.99 (0.86)	13.83 (0.67)	18.11 (0.37)
Belgium		13.19 (0.70)	11.97 (0.80)	17.05 (0.45)	14.63 (0.55)	20.26 (0.26)	15.18 (0.58)	16.86 (0.43)	14.30 (0.57)	19.83 (0.30)
Finland			16.71 (0.49)	15.15 (0.57)	16.23 (0.51)	18.93 (0.33)	13.78 (0.68)	19.15 (0.32)	17.97 (0.43)	15.59 (0.54)
France				16.47 (0.50)	12.84 (0.75)	16.03 (0.53)	12.59 (0.76)	15.67 (0.53)	14.10 (0.59)	15.59 (0.55)
Germany					14.00 (0.68)	18.62 (0.36)	12.23 (0.79)	9.28 (0.93)	13.48 (0.69)	13.48 (0.69)
Greece						16.17 (0.48)	13.18 (0.72)	18.03 (0.34)	15.09 (0.59)	13.50 (0.71)
Italy							13.69 (0.69)	18.87 (0.34)	13.97 (0.66)	14.03 (0.67)
Ireland								11.22 (0.85)	13.13 (0.73)	14.01 (0.67
Netherland									19.42 (0.31)	15.71 (0.57)
Portugal										17.33 (0.48)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted by a vector Z_t , using a χ^2 test with 17 degrees of freedom.

Table 2 Unrestricted GMM HP Results for EMU Countries, $H_0: E[X \mid Z] = 0$

	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Austria	23.24 (0.13)	23.48 (0.13)	17.01 (0.45)	9.45 (0.93)	6.87 (0.98)	10.25 (0.89)	10.41 (0.88)	13.19 (0.72)	18.82 (0.34)	18.34 (0.37)
Belgium		23.10 (0.13)	21.56 (0.21)	16.05 (0.50)	1.65 (0.99)	2.80 (0.98)	1.19 (0.99)	3.67 (0.98)	6.27 (0.97)	6.36 (0.97)
Finland			22.39 (0.17)	16.19 (0.51)	0.98 (0.99)	0.24 (0.99)	7.69 (0.97)	9.89 (0.91)	7.57 (0.96)	9.26 (0.95)
France				12.66 (0.75)	5.12 (0.98)	0.08 (0.99)	0.10 (0.99)	6.00 (0.97)	6.77 (0.97)	6.65 (0.97)
Germany					11.15 (0.85)	1.19 (0.99)	10.97 (0.86)	12.76 (0.78)	12.67 (0.76)	13.81 (0.73)
Greece						14.42 (0.63)	12.16 (0.79)	13.08 (0.73)	13.58 (0.74)	14.95 (0.60)
Ireland							16.14 (0.51)	5.14 (0.98)	8.35 (0.95)	11.59 (0.85)
Italy								17.13 (0.49)	14.72 (0.62)	16.86 (0.46)
Netherlands									14.68 (0.63)	16.39 (0.47)
Portugal										18.37 (0.37)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted by a vector Z_t, using a χ^2 test with 17 degrees of freedom.

Table 3 Unrestricted GMM LT Results for EMU Countries, $H_0: E[X \mid Z] = 0$

	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Austria	15.77 (0.54)	18.15 (0.38)	16.05 (0.52)	19.53 (0.30)	7.92 (0.97)	8.25 (0.95)	281 (0.00)	18.95 (0.37)	16.28 (0.50)	22.39 (0.17)
Belgium		12.39 (0.78)	20.91 (0.23)	19.71 (0.25)	8.78 (0.95)	7.14 (0.97)	65.59 (0.00)	21.66 (0.22)	20.78 (0.24)	23.11 (0.14)
Finland			18.85 (0.37)	18.24 (0.38)	8.32 (0.96)	7.82 (0.97)	157 (0.00)	19.49 (0.30)	20.14 (0.25)	22.04 (0.17)
France				18.56 (0.37)	7.20 (0.97)	5.67 (0.98)	1343 (0.00)	20.13 (0.28)	20.81 (0.25)	23.43 (0.14)
Germany					7.78 (0.97)	4.69 (0.98)	1537 (0.00)	23.33 (0.14)	21.24 (0.22)	23.96 (0.12)
Greece						8.12 (0.96)	8.82 (0.94)	20.33 (0.28)	20.54 (0.25)	21.09 (0.22)
Ireland							7.14 (0.97)	18.88 (0.37)	18.6 (0.35)	19.18 (0.30)
Italy								20.55 (0.28)	21.22 (0.22)	22.39 (0.17)
Netherlands									19.36 (0.30)	22.06 (0.17)
Portugal										22.54 (0.16)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted by a vector Z_t using a χ^2 test with 17 degrees of freedom.

Unrestricted estimates of the model for EMU countries lead to rejection of the hypothesis of complete risk-sharing $E_t [X_t | Z_t] = 0$ only in LT detrended data (table 3) in the case of Italy. Rejections over long cycles were present in the pairs Italy-Austria, Italy-Belgium, Italy-Finland, Italy–France, and Italy-Germany. Canova and Ravn's estimates for long cycles show preponderant rejection of the null in medium- and long-term cycles, and thus the results presented here are in line with their findings.

Tables 4-6 show similar results from the *unrestricted estimates of CC* countries. There are 2 rejections for short cycles (FOD detrended data), none for medium cycles (HP detrended data), and 2 rejections for long term cycles (LT detrended data). The hypothesis of complete risk-sharing $E_t [X_t | Z_t] = 0$ was rejected for the pairs Slovenia-Hungary and Slovenia-Lithuania over short cycles (table 4) and for Lithuania-Poland, Lithuania-Hungary for long cycles (table 6).

The similarity of outcomes for both EMU and CC countries is somewhat surprising. Economic, financial and even political ties between the CC countries have quite different nature compared to the members of the European Union and one would expect to find stronger rejection of the orthogonality conditions in the former case. Nevertheless, it would probably be misleading to conclude that consumption risk sharing is overwhelmingly present across the nine sampled countries. A more realistic explanation is that the data points available for econometric analysis were insufficient and this leads to distortion of econometric estimates typically applicable to large sample properties. For example, in the case of Slovenia, there were only 28 observations available, Poland and Hungary – 36, compared to the average of 40 for the other countries.

Table 4 **Unrestricted GMM FOD Results for CC Countries, H_0 : E [X | Z] =0**

	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia
Czech R.	16.22 (0.48)	11.15 (0.85)	16.91 (0.46)	18.64 (0.35)	20.92 (0.23)	16.92 (0.46)	17.03 (0.45)	11.07 (0.85)
Estonia		18.57 (0.35)	14.00 (0.66)	12.61 (0.76)	18.86 (0.31)	17.90 (0.39)	15.20 (0.58)	22.69 (0.16)
Hungary			17.19 (0.44)	18.54 (0.32)	17.64 (0.43)	16.51 (0.47)	18.10 (0.33)	28.08 (0.04)
Latvia				18.9 (0.31)	17.75 (0.43)	16.49 (0.47)	16.84 (0.46)	25.41 (0.09)
Lithuania					18.41 (0.34)	16.88 (0.46)	15.21 (0.58)	55.89 (0.00)
Malta						16.83 (0.46)	15.28 (0.58)	11.03 (0.85)
Poland							17.15 (0.42)	7.11 (0.98)
Slovakia								12.63 (0.76)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted using a vector Z_t using a χ^2 test with 17 degrees of freedom.

Table 5 **Unrestricted GMM HP Results for CC Countries, H_0 : E [X | Z] =0**

	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia
Czech R.	19.56 (0.30)	21.34 (0.21)	19.09 (0.31)	14.98 (0.60)	22.76 (0.16)	21.81 (0.20)	19.63 (0.30)	1.29 (0.99)
Estonia		21.07 (0.22)	22.9 (0.15)	18.02 (0.39)	23.99 (0.12)	23.05 (0.15)	20.07 (0.26)	3.16 (0.99)
Hungary			21.81 (0.23)	18.52 (0.38)	22.70 (0.16)	17.68 (0.40)	18.59 (0.38)	2.79 (0.99)
Latvia				17.75 (0.41)	23.77 (0.13)	23.77 (0.13)	17.58 (0.42)	2.65 (0.99)
Lithuania					20.19 (0.26)	19.79 (0.29)	13.26 (0.72)	7.79 (0.97)
Malta						22.76 (0.16)	24.62 (0.10)	6.86 (0.97)
Poland							25.33 (0.09)	7.85 (0.97)
Slovakia								0.37 (0.99)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted using a vector Z_t using a χ^2 test with 17 degrees of freedom.

Table 6 **Unrestricted GMM LT Results for CC Countries, H_0 : E [X | Z] =0**

	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia
Czech R.	12.93 (0.74)	21.14 (0.22)	17.14 (0.45)	20.30 (0.24)	13.33 (0.71)	20.80 (0.24)	16.33 (0.50)	7.85 (0.97)
Estonia		20.87 (0.23)	21.47 (0.21)	20.40 (0.23)	16.39 (0.50)	20.73 (0.23)	20.67 (0.23)	12.03 (0.79)
Hungary			20.72 (0.23)	30.78 (0.02)	16.12 (0.50)	14.73 (0.62)	20.11 (0.24)	9.67 (0.91)
Latvia				20.17 (0.24)	14.67 (0.62)	20.84 (0.23)	18.61 (0.35)	9.14 (0.92)
Lithuania					14.03 (0.63)	186.68 (0.00)	17.73 (0.37)	9.19 (0.92)
Malta						17.61 (0.44)	16.39 (0.50)	8.25 (0.94)
Poland							20.72 (0.24)	6.58 (0.97)
Slovakia								9.25 (0.91)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted using a vector Z_t using a χ^2 test with 17 degrees of freedom.

An alternative explanation of the observed results is the common history of most CC countries resulting in similar movements of consumption and income across the past decade. All CC countries, except for Malta and Cyprus, had centrally planned economies until the 1990s and started market-oriented reforms afterwards. During the sampled period all eight countries underwent trough quite similar phases even though the timing of some of the events varied across nations. The restructuring of these economies even followed similar plans of foreign teams of experts and encountered similar pitfalls along the way. Privatization, high inflation, currency devaluation, extensive national debt, unemployment, and newly born financial markets are among the economic traits shared by these countries. It is therefore possible that the consumption risk-sharing hypothesis is not rejected in the case of these three CC countries due to high correlation in their consumption patterns.

Results from the *restricted model* alter the above scenario. Rejections of the orthogonality conditions are proportionally higher for CC countries compared to EMU countries. In Appendix 4, tables A4-A6 present in detail the outcome of a test on the restricted model for the EMU countries and tables A7-A9 - for the CC countries.

A summary of the restricted GMM estimations is presented in table 7. A common trend for both groups of countries is that rejections of the null hypothesis of complete consumption risk insurance escalate with the length of the business cycle. Therefore over the short run consumption risk sharing is rejected in just 11% of the EMU country pairs, while the level of rejection rises to 93% over the long run. Rejections of the null hypothesis of complete consumption risk sharing in the CC group outnumber proportionally those in the EMU group in all three cycle-lengths. Correspondingly to the

EMU group, the number of rejections in the CC group increases over longer cycles. The largest difference between the two sets of countries appears to be in the HP model or over medium cycles. At this specification rejections for the CC countries are almost twice as high as for the EMU countries.

Table 7 **Summary results from Restricted GMM estimation**

	EMU countries		**CC countries**	
	Number of Rejections	Percent of Total	Number of Rejections	Percent of Total
FOD	6	11%	7	19%
HP	27	49%	32	89%
LT	51	93%	34	94%

Canova and Ravn use a different set of instruments including lagged shocks to real, demographic and nominal variables, and they report failure to reject the orthogonality conditions. The difference in results, however, might be influenced by the fact that they use a different set of instruments.

A review of the literature shows that a number of empirical studies on consumption and income risk-sharing report results supporting the hypothesis that financially and monetarily unified regions show higher and more consistent risk-sharing compared to non-members of such unions. The cases preferred for such study are usually provinces within federal republics. Crucini (1999) and Crucini and Hess (1999) find much higher risk sharing levels among Canadian and United States provinces compared to a group of seven OECD countries. Similarly Kalemi-Ozcan, Sorensen, and Yosha (2000) document much higher level of income risk-sharing among provinces of a single country, e.g. Italy, the United States, Canada, and the United Kingdom versus groups of countries – EC countries, non-EC countries and Latin American countries. Likewise, Zhang and Ogaki (2000) report statistically significant results for consumption risk-sharing patterns within villages in India, but reject risk-sharing between different villages emphasizing that geographical remoteness poses problems with flow of private information.

The theory of international consumption risk sharing implies also a set of cross-equation constraints on the slopes of (22)-(24). These constraints can be used to perform an alternative to the orthogonality conditions test of the theory. With the preceding tests I examined whether X_t can be predicted by the instruments. In the current case I will use a Wald test to check whether the moment conditions contain the same information. If the cross-equation restrictions hold, it implies that the transformation of the slope coefficients of the three moment conditions equals the ratio of the coefficients of relative risk aversion of the two paired-countries.

The *Wald test on the cross-equation restrictions* has mixed results (Appendix 5). For both groups of countries cross-equation restrictions are rejected mostly over medium (HP detrending) and long cycles (LT detrending), while fewer rejections are observed over the short cycles. The total number of rejections is greater for the CC countries (74% of the cases) compared to the EMU countries (50% of the cases). These results are in line with Canova and Ravn's findings that cross-equation restrictions are rejected in an overwhelming number of cases, no matter what type of detrending is utilized. With the Wald test estimates I can conclude that even though the moment conditions vector X_t appears to be unpredictable in some cases, the stronger implication that the information contained in (22)-(24) is the same is rejected.

In summary, after applying Canova and Ravn's model to the EMU and CC data I find support for the null hypothesis of complete consumption risk sharing in majority of cases in both groups. These results are conditional on the type of estimation, restricted or unrestricted, as well as on the kind of detrending procedure used. Restricted GMM estimates lead to proportionally greater number of rejections in the CC region and a Wald test on the cross-equation restrictions similarly shows more rejections for the CC countries. Based on these outcomes, I can conclude that there is stronger evidence for consumption risk sharing within the EMU region than among the CC countries, as predicted by the theoretical reasoning offered in section II above.

Chapter 4

EXTENT OF CONSUMPTION RISK SHARING

4.1 Model

In this section of the paper I would like to quantify the degree of risk insurance achieved by the EMU members, as well as by the CC countries. I follow the model proposed by Crucini (1999) and Crucini and Hess (1999).

Crucini's model (1999) builds upon the FOC equations (11c) - (16) stated above. Equation (16) is where country's *j* consumption is related to the average consumption of the region:

$$\log U^j_c - \log U^a_c = \psi_{aj} \qquad \text{with } \psi_{aj} = \log \Phi_a - \log \Phi_j \tag{16}$$

Crucini uses a modified version of the CRRA utility function (18) of the form:

$$U(c^j_t, b^j_t) = \exp((1-\sigma) b^j_t) \frac{1}{1-\sigma}\left[(c^j_t)^{1-\sigma} - 1\right] \; if \sigma_j > 0 \tag{25}$$

where σ is the coefficient of constant relative risk aversion, c^j_t is consumption for the representative household in country *j* and b^j_t is an exogenous preference shock to country j given the state of nature. Taking the first derivative with respect to c^j_t and transforming in logs (25) I obtain:

$$\log U_c(c^j_t, b^j_t) = (1-\sigma)\, b^j_t - \sigma \log c^j_t \tag{26}$$

After aggregating over the *J* countries in the region and taking the first difference, I substitute (26) in (16) to obtain:

$$\Delta \log c^j_t = \Delta \log c^a_t + \left(\frac{1-\sigma}{\sigma}\right)\Delta\left(b^j_t - b^a_t\right) \tag{27}$$

where $b_{at} = (1/T)\, \Sigma_{t=1} b_{jt}$, and $\log c_{at} = (1/J)\, \Sigma_{j=1} c_{jt}$. With CRRA utility, changes in consumption of each individual move one-for-one with the change in average consumption holding fixed the preference shock. This is the assumption of the perfect risk sharing hypothesis where consumption growth should be perfectly correlated across countries.

Crucini's model, however, introduces the assumption that consumption risk insurance, although existent, is not perfect or complete. Baxter and Crucini (1995) show that the observed deviations from complete risk sharing will be larger the more persistent are the output shocks each nation faces. The intuition is that highly persistent shocks combined with incomplete markets will make countries' permanent income diverge more, so that in turn, consumption will have a smaller common component.

Crucini outlines a risk sharing process in the formation of the income stream of the agents, such that a share (λ) of individual's income comes from the total stream of pooled income at federal or union level and the rest (1- λ) comes from other income not associated with risk pooling. The income after risk pooling is defined as:

$$\overline{Y_{jt}} \equiv \lambda Y_{at} + (1-\lambda)Y_{jt} \qquad (28)$$

where Y_{at}= $(1/\Lambda)\ \Sigma_{j=1}\ \lambda_j$ Yjt ,Y_{jt} is the income of individual *j* at time *t,* and Λ=. $\Sigma_{j=1}\ \lambda_j$ Since it will be difficult to capture empirically how much each individual contributes to the pooled resources, Crucini assumes that individuals in a particular risk-sharing group each contribute the same amount, but the parameters may differ across the groups. For the purpose of this study and in order to stay consistent with previous notation, j = 1,...J will denote a nation state, the smallest unit of measurement.

The model assumes that individuals smooth consumption by borrowing or lending at a fixed exogenous real interest rate $r = \beta^{-1}-1$ or $r = 1-\beta$. Then the decision rule for consumption smoothing can be presented as a process where income is altered as a consequence of risk sharing (as in budget constraint (8)):

$$\Delta C_{jt} = (1-\beta)\sum_{k=0}^{\infty}\beta^k [E_t \overline{Y}_{jt+k} - E_{t-1}\overline{Y}_{jt+k}] \tag{29}$$

When the decision rule in (29) is summed across all countries by substituting (28) for $\overline{Y_{jt}}$, it leads to the following expression for the average change in consumption:

$$\Delta C_{at} = \frac{1}{J}\sum_{j=1}^{J}\Delta C_{jt} = (1-\beta)\sum_{k=0}^{\infty}\beta^k [E_t \overline{Y}_{ajt+k} - E_{t-1}\overline{Y}_{at+k}] \tag{30}$$

Specifically, each term in the infinite sum can be written as follows:

$$\begin{aligned} E_t \overline{Y}_{jt+k} - E_{t-1}\overline{Y}_{jt+k} &= E_t[\lambda Y_{at+k} + (1-\lambda)Y_{jt+k}] - E_{t-1}[\lambda Y_{at+k} + (1-\lambda)Y_{jt+k}] = \\ \lambda[E_t Y_{at+k} - E_{t-1}Y_{at+k}] &+ (1-\lambda)[E_t Y_{jt+k} - E_{t-1}Y_{jt+k}] = \lambda\Delta C_{at} + (1-\lambda)\Delta C_{jt} \end{aligned} \tag{31}$$

Using (29), (30) and (31), the original decision rule becomes:

$$\Delta C_{jt} = \lambda\Delta C_{at} + (1-\lambda)(1-\beta)\sum_{k=0}^{\infty}\beta^k [E_t Y_{jt+k} - E_{t-1}Y_{jt+k}] \tag{32}$$

Expression (32) states that regional consumption growth responds to permanent income defined as the linear combination of the annuity value of innovations to aggregate per capita and regional per capita income. The parameter λ is interpreted as the extent of consumption risk sharing. In the presence of risk sharing, consumption changes are then influenced by unanticipated shocks to income. λ can range from 0 to 1 with λ = 0 when no risk sharing is present among countries, and on the other extreme λ = 1 for complete risk sharing. Each country's consumption change will be driven by the revisions in their own permanent income.

In order to forecast regional income growth, Crucini proposes three different data-generating processes for innovations to income. These processes attempt to capture disturbances originating at both the regional and union level:

$$\begin{pmatrix} \Delta y_{at} \\ \Delta y_{jt} \end{pmatrix} = \begin{pmatrix} A_j^{11} A_j^{12} \\ A_j^{21} A_j^{22} \end{pmatrix} \begin{pmatrix} \Delta y_{at-1} \\ \Delta y_{jt-1} \end{pmatrix} + \begin{pmatrix} v_{at} \\ v_{jt} \end{pmatrix} \quad (33a)$$

$$\Delta y_{jt} = \rho\, \Delta y_{jt-1} + v_{jt} \quad (33b)$$

$$\Delta y_{jt} = v_{jt} \quad (33c)$$

In (33a) Crucini allows aggregate and regional news to interact and produce disturbances jointly. This method also permits capturing the extent to which aggregate and regional income growth can be predicted by past growth rates. The coefficients on aggregate and regional news in (33a) are defined as B^{ij} with the *ij*th element equal to $(I - \beta A_j)^{-1}$, weighted by the risk-sharing parameters. In (33b) innovations to regional income are generated following an autoregressive process of order one (AR1), while in (33c) income is a random walk.

Estimation is conducted in two stages. The first stage estimates the three different data-generating models for income (33a-c) and constructs a time-series of innovations to permanent income for each state. The second stage estimates equation (32), which has been transformed in logs. Using lower case to identify logged variables, (32) is represented as:

$$\Delta c_{jt} = \lambda \Delta c_{at} + (1-\lambda)\Delta y\hat{p}_{jt} + \varepsilon_{jt} \quad (34)$$

Equation (34) becomes very similar to (16) of Canova and Ravn's model, with $y\hat{p}_{jt}$ capturing unexpected changes in regional permanent income. (34) is estimated using the time-series of innovations to permanent income $y\hat{p}_{jt}$ computed in the previous stage (33a-c). Each equation is estimated separately to avoid the problem of regressing regional consumption growth on its cross-sectional mean. I use ordinary least squares procedure for all estimations.

4.2 Data

Data for this model are the same as for the corresponding variables in the previous model (consumption and income). The difference is that first, both consumption and income are per capita variables, and second, both variables are in real US $. The reason for the dollar conversion is that I am constructing an aggregate measure for consumption and output per capita using the currencies of 20 different countries. If the variables are left in their national currency, different denominations added together may not reflect true movements in consumption and income patterns, which could be significant for one country, but can be lost in the aggregate measure. In addition, changes in the exchange rate reflect also the domestic inflationary pressure, thus accounting for the inflationary process in that country.

4.3 Unit Root Test

The variables in this model have the same specifications as in the previous one and the unit root results cited in section III/3 apply here. The stationarity procedure employed here is first order differencing.

4.4 Empirical results

4.4.1 Degree of risk-sharing within the EMU and CC regions

The model presented in this section assumes imperfect risk-sharing and attempts to quantify the degree of risk sharing occurring for members of a region. The intuition here is that members of the EMU will have on average higher degree of risk-sharing compared to candidate countries (CC) due to a greater number of channels for risk diversification available across an economic and monetary union like the EMU. Furthermore, it will be rational to expect that the value of the risk-sharing parameter λ has increased after the acceptance of the Maastricht treaty (1991) envisaging financial and monetary unification of the EU compared to pre-Maastricht years.

First are reported the results of estimating the income processes as described in (33a-c). Tables 8 and 9 present the coefficients for three EMU and three CC countries for which a test at the 5% level of significance reveals positive or negative coefficient. The other values reported are the weighting coefficients for innovations to regional and aggregate income denoted "multipliers" or the B^{ij} defined before as the *ij*th element equal to $(I- \beta A_j)^{-1}$ with $\beta = 0.98$, and the R-squared.

Table 8 First-Stage Income Regression-EMU Countries

		Aggregate Income			Regional Income			Univariate AR1	
		A^{11}	A^{12}	R^2	A^{21}	A^{22}	R^2	ρ_j	R^2
Austria	sign tests	[1,0]	[0,0]	0.45	[0,0]	[1,0]	0.56	[1,0]	0.55
	multipliers	2.11	0.19		0.56	1.73		0.50	
France	sign tests	[1,0]	[0,0]	0.44	[0,0]	[1,0]	0.45	[0,0]	0.45
	multipliers	2.40	0.48		0.47	1.50		0.50	
Germany	sign tests	[0,0]	[0,0]	0.44	[0,0]	[0,0]	0.45	[1,0]	0.44
	multipliers	1.42	0.50		-0.17	0.65		0.50	

Notes: Sign test [x,y] show the number of statistically significant positive (+) or negative (-) coefficient in each country at the 5% level.

Table 9 **First-Stage Income Regression-CC Countries**

		Aggregate Income			Regional Income			Univariate AR1	
		A^{11}	A^{12}	R^2	A^{21}	A^{22}	R^2	ρ_i	R^2
Czech R.	sign tests multipliers	[1,0] 1.8	[0,0] 0.17	0.47	[0,0] 0.15	[1,0] 2.04	0.57	[0,0] 0.14	0.19
Hungary	sign tests multipliers	[1,0] 1.71	[0,0] 0.26	0.63	[0,0] 0.35	[1,0] 2.19	0.77	[0,1] 0.54	0.26
Poland	sign tests multipliers	[1,0] 1.73	[0,0] 0.29	0.65	[0,1] -0.07	[1,0] 2.25	0.83	[0,1] 0.58	0.34

Notes: Sign test [x,y] show the number of statistically significant positive (+) or negative (-) coefficient in each country at the 5% level.

For presentational simplicity the author has chosen not to report the coefficients for all 20 countries, since they are quite similar to the sampled ones. The number of statistically significant coefficients in the aggregate income equations for the EMU countries is the same as for the regional income equations. For the CC countries, however, there are four statistically significant coefficients on the regional income equations versus three on the aggregate income. The R-squares are also on average higher for the regional income compared to the aggregate income. These estimates indicate that aggregate income is unpredictable or random walk, while regional income growth is predictable by past growth rates. Crucini (1999) has similar findings for a sample of OECD countries.

The last two columns of the tables report results for the univariate first-order autoregressive model of regional income growth. Two coefficients from each set of countries are statistically different from zero. Based on these findings one can conclude that the bivariate model seems to offer a better fit than the univariate model as evident from the fewer statistically significant coefficients.

Estimation of the model presented in (34) was conducted utilizing three different specifications of innovations to the income process (33a-c). I used ordinary least squares at all stages of the estimation. The following table 10 includes a row for each type of income innovation process, as well as estimates of the risk-sharing parameter λ and the regression's R-squared, which have been averaged over each type of estimation process (random walk, AR1, or bivariate) across all countries belonging to one group or the other. For example, column 2, row 1 reports the $\lambda = 0.65$ obtained by averaging the values of λ in the random walk specification across all EMU countries. Detailed estimates are shown in Appendix 6, tables A12 and A13.

Table 10 Risk Sharing Parameters Within Regions

	Mean Statistics		Mean Statistics	
	λ	R^2	λ	R^2
	Results for the EMU countries		Results for the CC countries	
Random Walk	0.65	0.54	0.42	0.32
Univariate	0.53	0.51	0.40	0.26
Bivariate	0.79	0.56	0.50	0.40

Risk sharing parameter λ has a range between 0 (no consumption risk insurance) and 1 (complete consumption risk insurance)

Examination of the results presented in table 10 leads to the observation that EMU member countries have higher average level of risk sharing compared to CC countries. The size of λ ranges form .53 to .79 for the EMU countries and from .40 to .50 for the CC countries. Among the EMU group the highest coefficient of the risk-sharing parameter λ is for Finland and Spain, both with λ=1.00 in the bivariate specification, followed by Belgium and France with λ=.99. The lowest estimate among the EMU is for Greece where λ= -.05 in the AR1 specification, which also has a p-value = .49 or equivalently is not significantly different from zero (no consumption risk sharing).

In addition to being smaller, the parameter representing degree of risk insurance among the CC countries is not significantly different from zero on several occasions. The lowest estimate of λ is for Poland = -.20 in the AR1 specification and none of the three different estimates of the parameters for Poland is statistically significant. Other insignificant coefficients include the bivariate estimation for the Czech Republic and Slovakia. An ADF test on the residuals of the bivariate model confirms the presence of a unit root and could thus point non-stationarity as the possible cause for the value of λ in this case. The highest estimate is for Hungary where $\lambda = 1.04$ in the bivariate specification, followed by Slovakia with $\lambda = .87$ random walk specification.

It is also noticeable that results depend on the type of income innovation process chosen for the estimation. For both EMU and CC countries the bivariate model gives the highest λ, followed by the Random Walk and the autoregressive model of order 1.

The estimated equations account for considerable fraction of the time-series variation in regional consumption growth of the EMU countries. R-square ranges from .51 to .56 in the EMU countries, with the lowest observation of .03 coming from the bivariate estimation in Greece and the highest of .88 from the bivariate estimation in Belgium. In the case of the CC countries R-square is noticeably lower, ranging from .26 to .40, Hungary being at the lowest end with $R^2 = .01$ at the bivariate estimation and Slovenia at the top with $R^2 = .83$ at the random walk estimation. It is noticeable that Slovenia appears as an extreme outlier with its high values for both lambda (risk sharing) and R-square.

Even if I consider Slovenia a border case, regional consumption patterns for the CC countries seem to be not quite well matched by the model in (34). This finding is not very surprising in view of the still pertinent for these transition countries grey economy. Specifically, consumption patterns are not entirely related to the income stream originating from documented labor or capital investment, or even less financial markets. A number of rural inhabitants compensate the lack or instability of cash income by small farm production for personal needs and retail. These activities fall under both consumption and income categories, but remain unrecorded for official statistical purposes. Thus, incompleteness and measurement error might explain the inability of (34) to match the data.

Table 11 **Test on Parameters and Restrictions**

	Wald test H_0: λ=1 (number of significant results)		Number of rejections of the overidentifying restrictions at P-value =.05	
	EMU	**CC**	**EMU**	**CC**
Bivariate	1	1	1	3
Univariate	0	1	0	2
Random Walk	6	0	1	4

Table 11 reports two additional tests of the model. The second and third column present the number of times the risk sharing parameter λ equals one or complete consumption risk insurance is not rejected for particular country. The EMU group continues to show higher level of consumption risk sharing with overall greater number of cases when λ is not significantly different from one. Nevertheless, the overwhelming majority of rejections lends support to the assumption behind this model that risk insurance, even if present, is imperfect.

A test on the overidentifying restrictions of the model is presented in the last two columns of the table. At 5% significance level I observed 2 rejections across the EMU countries and 9 rejections across the CC countries. Crucini (1999) reports similar results with rejections averaging 2 for Canadian provinces, 5 for US provinces, and 1 for OECD countries.

To précis the above findings, I find support for the assumption that countries with closer economic ties achieve considerably higher level of consumption and income risk insurance compared to those that do not share such ties. The risk sharing parameter λ has larger values for the EMU countries compared to the CC countries with overall group difference reaching a 1.5 fold magnitude in favor of the EMU group. Furthermore, parameter estimates of λ demonstrate the presence of complete consumption risk sharing (λ =1) on more occasions within the EMU group than within the CC group of countries. Finally, stronger rejection of the model restrictions within the CC group shows the difficulty with which this model captures consumption and income variations with the CC countries.

4.2.2 Consumption risk sharing between EMU and CC countries

This section examines application of the model presented in (33a-c) and (34) with regards to interaction between the countries of the two regions. Such interpretation of the model will allow me to examine the current status of consumption risk-sharing among the candidate countries and the EMU members. For example, to test the level of consumption risk sharing of the Czech Republic with the EMU region, I regress Czech consumption on EMU aggregate consumption and Czech income innovations. When using (33a) as specification of income innovations, the parameter measuring innovations to aggregate income quantifies the opposite region's income, e.g. in the above case innovations to aggregate income refer to EMU's aggregate income, while regional income changes refer to Czech income.

Table 12 reports summary results of the parameter estimates testing the hypothesis of incomplete consumption risk-sharing between EMU and CC countries. The table includes a row for each type of income innovation process, as well as estimates of the risk-sharing parameter λ and the regression's R-squared, which have been averaged over a certain type of estimation process (random walk, AR1, or bivariate) across all countries belonging to one or the other group. Detailed results are presented in tables A14 and A15 in Appendix 6.

Table 12 Risk Sharing Parameters Between the EMU and CC

	Mean Statistics		Mean Statistics	
	λ	R^2	λ	R^2
	Results for the EMU-CC		Results for the CC-EMU	
Random Walk	0.28	0.29	.70	0.42
Univariate	0.22	0.44	.68	0.38
Bivariate	0.18	0.32	.75	0.35

An immediate observation from table 12 is that the values of λ measuring consumption-risk sharing between the EMU countries and the CC region are considerably lower compared to those representing the process among the EMU countries themselves. Lambda ranges from .18 to .28, which is substantively lower than the internal EMU range of .53 to .79 reported in the previous section. This result is supportive of the hypothesis that EMU countries achieve much higher level of consumption risk-sharing diversifying risk across the members of the union versus non-member countries. The benefits available to union members can barely spread across the borders of the union and this makes union membership more desirable to outsiders. Such findings reinforce the argument in favor of an economic and monetary union when membership results in better consumption risk-sharing.

Average consumption risk sharing between CC countries and the EMU, on the other hand, extends from .68 to .75, which is significantly greater than the .40 to .50 range of λ within the CC region itself. This result stands out also in comparison with the respective lambda estimates for the EMU countries' interaction with the CC region. Parameter estimates for the CC group point towards a higher level of risk sharing occurring between candidate countries and the core countries of the union they will join (EU) compared to the one occurring only among candidate countries. The numerous synchronization acts approved by the candidate countries as a precondition for joining the EMU might have enhanced consumption synchronization at least one way, i.e. CC countries-EMU, not EMU-CC countries.

Similar to the estimations in the preceding section looking at within-region dynamics, the choice of income process reflects on the parameter estimates also in the current section looking at between-region dynamics. Unlike the previous section, though, the two groups have differences in what type of process leads to the highest or lowest value of lambda and R-squared. For the EMU countries, the highest lambda of .28 results from the random walk process and the lowest of .18 – from the bivariate process. Among the CC countries, the highest lambda of .75 results from the bivariate estimation and the lowest of .68 from the univariate estimation.

A look at the R-squared shows that in both groups the estimated equations account for less than a half of the time series variation of regional consumption growth. R-squared is between .29 and .42 for the EMU-CC estimation and between .35 and .42 in the CC-EMU estimation. These findings relate that the model in (33a-c) and (34) does not offer a good match for the data or equivalently there are other processes explaining the dynamics on the consumption-income plane in a 2-region interaction set up.

Another observation originating in the empirical results is that both member and non-member countries can gain from an enlargement of the union. While the degree of risk sharing among EMU members is relatively high, it differs from one member to the other and can certainly be enhanced. The addition of new members to the EMU will benefit the core countries by offering a different avenue for risk-diversification, which has not been exploited fully yet. Furthermore, comparison between the average risk-sharing in the CC (.40-.50) and in the EMU (.53-.79) unveils clearly the advantage of membership in economic union. The gains from consumption risk sharing to CC countries can be up to 2 times the current value. Thus, union enlargement is expected to enhance consumption risk sharing for both new and core countries. In this regard, it will be interesting to conduct a future study of the countries admitted in the EU after the 2004 enlargement and follow their progress in time.

Support for the above empirical outcome can be found in a number of studies. From theoretical point of view, von Furstenburg (2002) argues that complete financial markets, as the one within a monetary union, bring substantive welfare gains in consumption and income risk-sharing. Neumeyer's (1998) model demonstrates that there could be potential welfare gains in a monetary union for countries where exchange rate volatility arises from political shocks. Cruini and Hess (1999) find a much higher level of consumption risk sharing for provinces of federations with single monetary and financial policy like the US (λ is between.84 -.94) and Canada (.88 -.90) compared to countries with not as strong economic ties, e.g. OECD (.37-.60).

Summarizing the results of this section, I find evidence that consumption risk sharing between the EMU and CC region is far from optimal. The level of economic and financial interaction between the core members of the European Union and the new applicants for membership is below the average for the EMU countries alone. Theoretical reasoning and empirical results both demonstrate the significant value of economic unification for consumption risk insurance.

Chapter 5

THE TWO MODELS - DISCUSSION

To test whether consumption risk sharing is present within the EMU and CC regions, I used Canova and Ravn's model (1996), outlined in Section III. Restricted and unrestricted GMM estimates of the orthogonality conditions imposed by the model implied that complete consumption risk insurance can be hypothesized in both regions mostly over short-term and medium-term cycles and to a smaller extent over long-term cycles. The results obtained through this model ascertain a positive answer to the first question posed in the introductory part of the present survey: Is there consumption risk-sharing among the EMU core countries, as well as among the candidate countries?

While the restricted estimation and Wald test results both point to a more consistent and comprehensive consumption risk insurance in the EMU region, the unrestricted results could not demonstrate significant difference between the EMU and CC countries. This puzzling outcome could be reexamined in light of the second model described in Section IV – Crucini's model (1999). Crucini's insight is that even if present, consumption risk sharing is probably less than perfect in majority cases and a parameter quantifying the level of consumption risk insurance is more representative as a measure of the true nature of the underlying economic processes. Reviewing the values of λ for the EMU and CC groups, one can see clearly the dominance of the EMU over the CC in terms of higher and more consistent consumption risk sharing. With these findings at hand, the lack of significant difference between EMU and CC results in the unrestricted estimation of Canova and Ravn's model could be attributed to the small sample's inability to reject the model. Consequently, Crucini's model reinforces the proposition of broader and deeper consumption risk sharing among the EMU group compared to the CC group, also demonstrated in Canova and Ravn's restricted moment conditions.

Crucini's model provides answers to the second and third inquiries of my survey: What is the degree of consumption risk sharing within, as well as between the EMU and CC countries? What would the accession in 2004 bring for both sets of countries in this regard? It was demonstrated that the countries belonging to the European economic and monetary union have better results in sharing consumption risk compared to non-member countries from the CC group. Furthermore, findings from the interactive model showed that both EMU and CC countries could gain from unification in achieving improved and more sustained diversification of risk across the states. This is an encouraging potential for the upcoming historic enlargement.

Chapter 6

CONCLUSION

This paper looked at the level of consumption risk sharing for two types of countries: one, belonging to the EMU, the other united simply by their status as candidates to join the EMU (CC). Section II examines existing literature grouped under the subheadings of monetary union and consumption insurance. Section III reviews the theoretical assumptions behind consumption risk sharing and offers a model testing complete consumption risk insurance. Section IV proposes a model capturing the degree of risk sharing for each country, member of one of the groups. The last model proposes a parameter quantifying the degree of risk sharing for each country. With these two models I examine the proposition that consumption risk sharing is greater among the countries belonging to the EMU compared to the CC and that both CC and EMU countries can gain from enlargement of the union in achieving more efficient and optimized risk-sharing.

The empirical results are presented within each respective theoretical section. With the first model I find that aggregate domestic consumption covaries with some of the instruments and leads to rejection of the null hypothesis of complete consumption risk sharing more often for the CC compared to the EMU countries. The shorter the cycle length, the better the evidence is for optimal consumption allocation across countries. Using the second model I find that the average degree of risk sharing among EMU countries is approximately 1.5 times larger than that for CC countries. This result lends support to the hypothesis that members of an economic and monetary union can achieve higher level of risk diversification and sharing compared to countries lacking such close economic ties. Finally, I report the results for the extent of consumption risk sharing across the two regions. I find that EMU members share risk with nonmembers at a much lower level, often not significantly different from zero. The CC group though has better consumption risk sharing with EMU countries compared to the one within its own group. With this I conclude that both EMU and CC countries will gain in consumption risk sharing when the union is enlarged.

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Appendix 1

MAASTRICHT TREATY CRITERIA

Four conditions given by the Maastricht Treaty for joining the EMU (Eichengreen, 1993):

1. A country's inflation rate should converge to a level not too far above the Community's low inflation countries. The average rate of CPI inflation in the preceding 12 months must not exceed the inflation rates of the three lowest inflation member states by more than 1 ½ percent.
2. Nominal exchange rates should be stabilized. Qualifying countries should have maintained their exch. rates within normal EMS fluctuation bands for 2 years prior to entering EMU.
3. Convergence in interest rates – the long-term interest rates over the preceding year must have been no more than 2 % above those of the 3 best performing member states in terms of inflation.
4. Budget deficit should be no larger than 3% of GDP and gross public debt should be no larger than 60% of GDP.

Appendix 2
RESULTS FROM ADF UNIT ROOT TESTS

Table A1 **ADF Tests for First Order Differenced (FOD) Variables**

H_0: unit root is present

ADF Test for **France**- Consumption

C (log)				**1st Difference C**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau*
Zero mean	4	3.20	0.9996	Zero mean	4	-3.49	0.0006
Single mean	4	-1.98	0.2967	Single mean	4	-4.70	0.0002
Trend	4	-0.98	0.9422	Trend	4	-5.09	0.0003

ADF Test for **France**- GDP

Y (log)				**1st Difference Y**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	3.00	0.9993	Zero mean	4	-2.81	0.0053
Single mean	4	-0.45	0.8946	Single mean	4	-4.48	0.0004
Trend	4	-2.48	0.3385	Trend	4	-4.45	0.0029

ADF Test for **France**- CPI

S (log)				**1st Difference S**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	0.04	0.6925	Zero mean	4	-1.07	0.2559
Single mean	4	-4.12	0.0014	Single mean	4	-0.99	0.7542
Trend	4	-1.59	0.7889	Trend	4	-3.53	0.0414

ADF Test for **Czech**- Consumption

C (log)				**1st Difference C**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	1.02	0.9155	Zero mean	4	-2.02	0.0426
Single mean	4	-3.12	0.0336	Single mean	4	-3.21	0.0280
Trend	4	-1.88	0.6418	Trend	4	-3.92	0.0221

ADF Test for **Czech**- GDP

Y (log)				**1st Difference Y**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	1.40	0.9566	Zero mean	4	-2.37	0.0189
Single mean	4	-2.49	0.1251	Single mean	4	-2.71	0.0820
Trend	4	-4.41	0.0066	Trend	4	-2.71	0.2376

ADF Test for **Czech**- CPI

S (log)				**1st Difference S**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	0.79	0.8796	Zero mean	4	-1.38	0.1508
Single mean	4	-2.49	0.1262	Single mean	4	-1.19	0.6685
Trend	4	-1.31	0.8690	Trend	4	-2.37	0.3859

* Values of Tau such that $p<.05$ reject H_0 of unit root

Table A2 **ADF Tests for Hodrick-Presckott Filtered (HP) Variables**

H_0: unit root is present

ADF Test for **France**- Consumption

C (log)				**HP-filtered C**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau*
Zero mean	4	3.20	0.9996	Zero mean	4	-5.50	0.0001
Single mean	4	-1.98	0.2967	Single mean	4	-5.48	0.0001
Trend	4	-0.98	0.9422	Trend	4	-5.45	0.0001

ADF Test for **France**- GDP

Y (log)				**HP-filtered Y**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	3.00	0.9993	Zero mean	4	-2.60	0.0096
Single mean	4	-0.45	0.8946	Single mean	4	-3.73	0.0048
Trend	4	-2.48	0.3385	Trend	4	-3.71	0.0253

ADF Test for **France**- CPI

S (log)				**HP-filtered S**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	0.04	0.6925	Zero mean	4	-3.95	0.0001
Single mean	4	-4.12	0.0014	Single mean	4	-3.93	0.0025
Trend	4	-1.59	0.7889	Trend	4	-3.97	0.0121

ADF Test for **Czech**- Consumption

C (log)				**HP-filtered C**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	1.02	0.9155	Zero mean	4	-2.36	0.0197
Single mean	4	-3.12	0.0336	Single mean	4	-2.32	0.1720
Trend	4	-1.88	0.6418	Trend	4	-3.31	0.0811

ADF Test for **Czech**- GDP

Y (log)				**HP-filtered Y**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	1.40	0.9566	Zero mean	4	-3.08	0.0030
Single mean	4	-2.49	0.1251	Single mean	4	-3.12	0.0340
Trend	4	-4.41	0.0066	Trend	4	-4.08	0.0149

ADF Test for **Czech**- CPI

S (log)				**HP-filtered S**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	0.79	0.8796	Zero mean	4	-1.90	0.0556
Single mean	4	-2.49	0.1262	Single mean	4	-1.86	0.3484
Trend	4	-1.31	0.8690	Trend	4	-1.93	0.6173

* Values of Tau such that $p<.05$ reject H_0 of unit root

Table A3 **ADF Tests for Linearly Detrended (LT) Variables**

H_0: unit root is present

ADF Test for **France**- Consumption

C (log)				**LT-detrended C**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau*
Zero mean	4	3.20	0.9996	Zero mean	4	-1.39	0.1530
Single mean	4	-1.98	0.2967	Single mean	4	-1.37	0.5934
Trend	4	-0.98	0.9422	Trend	4	-1.35	0.8698

ADF Test for **France**- GDP

Y (log)				**LT-detrended Y**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	3.00	0.9993	Zero mean	4	-2.84	0.0048
Single mean	4	-0.45	0.8946	Single mean	4	-2.83	0.0573
Trend	4	-2.48	0.3385	Trend	4	-2.79	0.2028

ADF Test for **France**- CPI

S (log)				**LT-detrended S**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	0.04	0.6925	Zero mean	4	-1.51	0.1217
Single mean	4	-4.12	0.0014	Single mean	4	-1.51	0.5277
Trend	4	-1.59	0.7889	Trend	4	-1.66	0.7625

ADF Test for **Czech**- Consumption

C (log)				**LT-detrended C**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	1.02	0.9155	Zero mean	4	-0.97	0.2881
Single mean	4	-3.12	0.0336	Single mean	4	-0.89	0.7792
Trend	4	-1.88	0.6418	Trend	4	-1.56	0.7871

ADF Test for **Czech**- GDP

Y (log)				**LT-detrended Y**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	1.40	0.9566	Zero mean	4	-2.39	0.0180
Single mean	4	-2.49	0.1251	Single mean	4	-2.46	0.1329
Trend	4	-4.41	0.0066	Trend	4	-4.41	0.0066

ADF Test for **Czech**- CPI

S (log)				**LT-detrended S**			
	Lag	Tau	P<Tau		Lag	Tau	P<Tau
Zero mean	4	0.79	0.8796	Zero mean	4	-0.98	0.2855
Single mean	4	-2.49	0.1262	Single mean	4	-0.80	0.8064
Trend	4	-1.31	0.8690	Trend	4	-1.31	0.8690

* Values of Tau such that $p<.05$ reject H_0 of unit root

Appendix 3

MODEIFICATION OF MOMENTS EQUATIONS FROM CANOVA AND RAVN (1996)

The following moment conditions are provided by Canova and Ravn (1996) p.578:

(1) $E\{\log U^j_c\} = E\{\log U^k_c\} - \xi$ where $\xi = (\log \Phi_k + \log \Phi_j)$

(2) $\mathrm{var}\{\log U^j_c\} = \mathrm{var}\{\log U^k_c\}$

(3) $\mathrm{cov}\{\log U^j_c, \log U^j_c\} = \mathrm{cov}\{\log U^j_c, \log U^k_c\}$

The notation U^j_c denotes first derivative of the utility function with respect to consumption or $U[C^j]$.

Utility function:

$$U(c^j_t) = \frac{1}{1-\sigma}\left[(c^j{}_t)^{1-\sigma} - 1\right] \ if \sigma_j \neq 1 \forall j$$

The first derivative of the CRRA utility function is $C_j^{-\sigma}$. I substitute in the moment conditions (1)-(3) and have the following results:

- In (1) $\log C_j{}^{-\sigma_j} = \log C_k{}^{-\sigma_k}$ or the same as equation (11), p 579

(4) $\log c^j_t = \left(\frac{\sigma_k}{\sigma_j}\right) \log c^k{}_t + \xi$

- In (2) we have the second moment equivalent to eq (12) on p.579 :

(5) $(\log c^j_t)^2 = \left(\frac{\sigma_k}{\sigma_j}\right)^2 (\log c^k{}_t)^2$

- In (3), where I have objections, we look at the covariances of C in the 2 countries j and k:

$Cov_{j,k} = corr_{j,k} \times (st.dev._j)(st.dev._k)$ from the formula $corr_{j,k} = \frac{Cov j,k}{(st.dev.j)(st.dev.k)}$

Since according to (3) $cov_{j,k} = cov_{j,j}$, we can express the above relationship in the manner convenient for econometric interpretation:

$$\frac{1}{(\text{st.dev.j})(\text{st.dev.k})} = \frac{\text{corr}_{j,k}}{\text{cov}_{j,j}}$$

Substituting in the parameters of interest:

$$\frac{1}{\sqrt{(\log C^{-\sigma_j})^2 (\log C^{-\sigma_k})^2}} = \frac{corr_{j,k}}{(\log C^{-\sigma_j})^2}$$

$$\frac{1}{(\sigma^j)(\sigma^k)\sqrt{(\log C_j)^2 (\log C_k)^2}} = \frac{corr_{j,k}}{(-\sigma^j)^2 (\log C_j)^2}$$

Collecting the σ coefficients on the RHS we have:

$$(6) \qquad \frac{1}{\sqrt{(\log C_j)^2 (\log C_k)^2}} = \left(\frac{\sigma^k}{\sigma^j}\right) \frac{corr_{j,k}}{(\log C_j)^2}$$

This statement would have been equivalent to (13) of Canova and Ravn which looks like that:

$$X_{3,t} = \sqrt{(\log c^j)^2 (\log c^k)^2} - \left(\frac{\sigma^k}{\sigma^j} \right) corr\,(\log c^j, \log c^k)(\log c^j)^{-2}$$

if not for raising the first argument on the RHS to the -1.

I will proceed estimating the model proposed by Canova and Ravn with my equation (6) or equivalently equation (24) in the text instead of their equation (13):

$$(24) \qquad X_{3,t} = \left(\sqrt{(\log c^j)^2 (\log c^k)^2}\right)^{-1} - \left(\frac{\sigma_k}{\sigma_j} \right) corr\,(\log c^j, \log c^k)(\log c^j)^{-2}$$

Appendix 4

RESTRICTED GMM ESTIMATES FOR EMU COUNTRIES
(Canova and Ravn's model)

Table A4 **Restricted GMM FOD Results for EMU Countries, $H_0 : E [X | Z] = 0$**

	Belgium	Finland	France	Germany	Greece	Italy	Ireland	Netherlands	Portugal	Spain
Austria	20.44	21.79	28.35	16.57	18.23	22.42	13.6	16.84	19.90	19.83
	(0.25)	(0.19)	(0.04)	(0.48)	(0.37)	(0.17)	(0.70)	(0.47)	(0.28)	(0.28)
Belgium		18.07	25.28	19.97	46.46	21.13	15.18	18.57	21.31	20.56
		(0.38)	(0.09)	(0.28)	(0.00)	(0.22)	(0.58)	(0.35)	(0.21)	(0.25)
Finland			20.45	19.45	18.38	22.62	13.78	17.4	18.91	17.84
			(0.25)	(0.30)	(0.38)	(0.16)	(0.68)	(0.43)	(0.33)	(0.40)
France				16.41	14.54	20.75	12.59	17.92	27.58	16.49
				(0.49)	(0.63)	(0.23)	(0.76)	(0.39)	(0.05)	(0.49)
Germany					19.6	19.7	12.23	14.62	38.23	15.53
					(0.30)	(0.29)	(0.79)	(0.62)	(0.00)	(0.56)
Greece						16.19	13.18	53.97	20.79	26.6
						(0.48)	(0.72)	(0.00)	(0.24)	(0.06)
Italy							13.69	18.87	26.06	40.07
							(0.69)	(0.34)	(0.07)	(0.00)
Ireland								14.23	13.13	14.01
								(0.65)	(0.73)	(0.67
Netherlands									44.78	18.23
									(0.00)	(0.37)
Portugal										14.81
										(0.61)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted by a vector Z_t, using a χ^2 test with 17 degrees of freedom.

Table A5 **Restricted GMM HP Results for EMU Countries, $H_0 : E [X | Z] = 0$**

	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Austria	23.52	24.88	20.98	11.26	141.67	3.81	17.92	39.92	64.44	86.31
	(0.13)	(0.10)	(0.22)	(0.84)	(0.00)	(0.99)	(0.40)	(0.00)	(0.00)	(0.00)
Belgium		23.92	23.51	16.5	0.01	42.44	0.03	2.94	0.35	142
		(0.12)	(0.13)	(0.49)	(0.99)	(0.00)	(0.99)	(0.98)	(0.99)	(0.00)
Finland			23.7	26.65	14.65	0.54	42.83	0.02	16.39	54.99
			(0.12)	(0.06)	(0.62)	(0.99)	(0.00)	(0.99)	(0.48)	(0.00)
France				20.85	5.45	3.58	1.10	21.01	136	78.12
				(0.22)	(0.99)	(0.99)	(0.99)	(0.23)	(0.00)	(0.00)
Germany					10499	3.48	14.94	196	208	216
					(0.00)	(0.99)	(0.62)	(0.00)	(0.00)	(0.00)
Greece						4033	3664	2274	29081	67.8
						(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ireland							15390	13.61	29.33	19.81
							(0.00)	(0.70)	(0.03)	(0.00)
Italy								3836	200	401
								(0.00)	(0.00)	(0.00)
Netherlands									346	152
									(0.00)	(0.00)
Portugal										159
										(0.00)

Table A6 **Restricted GMM LT Results for EMU Countries, H_0 : E [X | Z] =0**

	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Austria	741 (0.00)	21.01 (0.19)	60.42 (0.00)	204 (0.00)	640 (0.00)	220 (0.00)	281 (0.00)	2028 (0.00)	485 (0.00)	982 (0.00)
Belgium		50.52 (0.00)	21.84 (0.19)	20.75 (0.24)	54.54 (0.00)	116 (0.00)	65.59 (0.00)	832 (0.00)	986 (0.00)	1261 (0.00)
Finland			21.23 (0.26)	21.79 (0.26)	39.54 (0.00)	3.27 (0.99)	157 (0.00)	236 (0.00)	191 (0.00)	511 (0.00)
France				4844 (0.00)	206 (0.00)	1790 (0.00)	1343 (0.00)	2843 (0.00)	23105 (0.00)	8964 (0.00)
Germany					471 (0.00)	1534 (0.00)	1537 (0.00)	1551 (0.00)	4252 (0.00)	6531 (0.00)
Greece						34.58 (0.01)	4951 (0.00)	976 (0.00)	4574 (0.00)	50497 (0.00)
Ireland							221 (0.00)	4259 (0.00)	12700 (0.00)	11469 (0.00)
Italy								485 (0.00)	442 (0.00)	717 (0.00)
Netherlands									122 (0.00)	289 (0.00)
Portugal										1413 (0.00)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted by a vector Z_t , using a χ^2 test with 17 degrees of freedom.

RESTRICTED GMM ESTIMATES FOR CC (Canova and Ravn's model)

Table A7 **Restricted GMM FOD Results for CC Countries, $H_0 : E\ [X \mid Z] = 0$**

	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia
Czech R.	20.1 (0.27)	13.04 (0.73)	24.64 (0.10)	18.84 (0.35)	21.3 (0.21)	20.46 (0.25)	19.78 (0.29)	14.53 (0.63)
Estonia		20.31 (0.26)	18.67 (0.35)	19.61 (0.30)	20.88 (0.23)	17.77 (0.40)	130.49 (0.00)	134.79 (0.00)
Hungary			38.88 (0.00)	18.17 (0.33)	25.08 (0.09)	17.22 (0.44)	32.05 (0.02)	19.16 (0.32)
Latvia				22.38 (0.17)	22.43 (0.17)	71.53 (0.00)	20.6 (0.25)	13.88 (0.68)
Lithuania					18.78 (0.34)	94.84 (0.00)	18.49 (0.36)	13.94 (0.70)
Malta						15.86 (0.54)	18.13 (0.32)	18.13 (0.38)
Poland							17.38 (0.42)	31.04 (0.02)
Slovakia								13.01 (0.73)

Table A8 **Restricted GMM HP Results for CC Countries, $H_0 : E\ [X \mid Z] = 0$**

	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia
Czech R.	1067 (0.00)	270 (0.00)	1379 (0.00)	37298 (0.00)	12443 (0.00)	122 (0.00)	63.15 (0.00)	1.54 (0.99)
Estonia		1681 (0.00)	6220 (0.00)	50882 (0.00)	14947 (0.00)	2325 (0.00)	30757 (0.00)	30757 (0.00)
Hungary			9566 (0.00)	19211 (0.00)	5313 (0.00)	39.34 (0.01)	20712 (0.00)	767 (0.00)
Latvia				74365 (0.00)	10831 (0.00)	18747 (0.00)	1585 (0.00)	1585 (0.00)
Lithuania					2700 (0.00)	18463 (0.00)	14233 (0.00)	1.23 (0.99)
Malta						78497 (0.00)	316 (0.00)	60595 (0.00)
Poland							1333 (0.00)	20.56 (0.24)
Slovakia								0.45 (0.99)

Table A9 **Restricted GMM LT Results for CC Countries, $H_0: E\ [X \mid Z] = 0$**

	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia
Czech R.	46.94 (0.00)	406 (0.00)	75.24 (0.00)	168 (0.00)	15.19 (0.58)	2032 (0.00)	125 (0.00)	71.07 (0.00)
Estonia		14100 (0.00)	459 (0.00)	340 (0.00)	30.57 (0.02)	5685 (0.00)	193 (0.00)	30.62 (0.02)
Hungary			30.53 (0.02)	1098 (0.00)	28.22 (0.04)	937 (0.00)	13455 (0.00)	314 (0.00)
Latvia				1234 (0.00)	230 (0.00)	13310 (0.00)	1216 (0.00)	2265 (0.00)
Lithuania					49.52 (0.00)	98.76 (0.00)	293 (0.00)	8338 (0.00)
Malta						18.13 (0.38)	193 (0.00)	514 (0.00)
Poland							23708 (0.00)	265 (0.00)
Slovakia								62.33 (0.00)

P-values (in brackets) in excess of 0.05 indicate failure to reject the null hypothesis that X_t a defined in (22)-(24) cannot be predicted by a vector Z_t , using a χ^2 test with 17 degrees of freedom.

Appendix 5

WALD TEST ON CROSS-EQUATION RESTRICTIONS
(Canova and Ravn's model)

Table A10 **Wald Test on restrictions $b_1^2 = b_3$ and $b_2 = b_3$ for EMU countries, Rejections, $\alpha = .05$**

Detrending	Country	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherl.	Portugal	Spain
FOD	Austria	0	0	2	0	0	0	0	0	0	0
HP		0	0	0	1	2	0	0	2	2	2
LT		2	1	1	1	2	2	2	2	2	2
FOD	Belgium		1	1	1	2	0	0	0	2	0
HP			0	0	0	0	1	0	0	0	2
LT			1	0	0	2	2	2	2	2	2
FOD	Finland			0	2	0	0	0	1	0	0
HP				0	2	2	2	2	0	2	2
LT				0	0	2	0	1	2	2	2
FOD	France				2	0	0	0	0	1	0
HP					2	1	1	0	2	1	2
LT					2	2	2	2	2	2	2
FOD	Germany					0	0	0	0	2	0
HP						2	0	0	2	2	1
LT						2	0	2	2	2	2
FOD	Greece						0	0	2	1	2
HP							2	2	2	2	2
LT							2	2	2	2	2
FOD	Ireland							0	0	0	0
HP								2	2	2	2
LT								2	2	2	2
FOD	Italy								0	2	2
HP									2	2	2
LT									2	2	2
FOD	Netherlands									2	0
HP										2	2
LT										2	2
FOD	Portugal										0
HP											2
LT											2

Total rejections = 182
Percent of total cases = 50%

Table A11 **Wald Test on restrictions $b_1^2 = b_3$ and $b_2=b_3$ for CC countries, Rejections, α =.05**

Detrending	Country	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia
FOD	**Czech**	2	2	2	0	0	1	0	0
HP		2	1	2	2	2	1	2	0
LT		2	2	2	2	1	2	2	2
FOD	**Estonia**		2	2	0	0	0	0	2
HP			2	2	2	2	2	2	2
LT			2	1	2	2	2	1	2
FOD	**Hungary**			2	0	0	0	2	1
HP				2	2	2	2	2	2
LT				0	2	0	2	2	2
FOD	**Latvia**				0	0	2	0	2
HP					2	2	2	2	2
LT					2	2	2	2	2
FOD	**Lithuania**					0	2	0	0
HP						2	2	2	2
LT						2	2	2	2
FOD	**Malta**						0	1	1
HP							2	2	2
LT							0	2	2
FOD	**Poland**							0	2
HP								2	1
LT								2	2
FOD	**Slovakia**								2
HP									2
LT									2

Total rejections = 160
Percent of total cases = 74%

Appendix 6

Table A12. **Risk Sharing Parameter Estimates – EMU, H_0: λ=0**

Austria

	lambda	p-value	R sq.
random walk	0.70	<.0001	0.49
AR 1	0.44	0.008	0.55
Bivariate	0.57	0.008	0.47

λ_{avrg}= 0.57 R^2_{avrg}= 0.50

Belgium

	lambda	p-value	R sq.
random walk	0.80	<.0001	0.53
AR 1	0.40	0.003	0.48
Bivariate	0.99	<.0001	0.88

λ_{avrg}=0.73 R^2_{avrg}=0.63

Finland

	lambda	p-value	R sq.
random walk	0.71	<.0001	0.6
AR 1	0.39	0.025	0.47
Bivariate	1.00	<.0001	0.04

λ_{avrg}=0.70 R^2_{avrg}=0.37

France

	lambda	p-value	R sq.
random walk	0.73	<.0001	0.41
AR 1	1.04	<.0001	0.82
Bivariate	0.99	<.0001	0.86

λ_{avrg}=0.92 R^2_{avrg}=0.70

Germany

	lambda	p-value	R sq.
random walk	0.88	<.0001	0.82
AR 1	0.80	<.0001	0.83
Bivariate	0.98	<.0001	0.7

λ_{avrg}=0.89 R^2_{avrg}=0.78

Greece

	lambda	p-value	R sq.
random walk	0.14	0.175	0.76
AR 1	-0.05	0.490	0.43
Bivariate	0.04	0.870	0.03

λ_{avrg}=0.04 R^2_{avrg}=0.41

Ireland

	Lambda	p-value	R sq.
random walk	0.37	0.003	0.30
AR 1	0.40	0.075	0.14
bivariate	0.61	0.089	0.04

λ_{avrg}=0.46 R^2_{avrg}=0.16

Italy

	lambda	p-value	R sq.
random walk	0.72	<.0001	0.51
AR 1	0.24	0.016	0.56
bivariate	0.74	<.0001	0.69

λ_{avrg}=0.57 R^2_{avrg}=0.59

Netherlands

	lambda	p-value	R sq.
random walk	0.75	<.0001	0.53
AR 1	0.32	0.004	0.56
bivariate	0.78	<.0001	0.83

λ_{avrg}=0.62 R^2_{avrg}=0.64

Portugal

	lambda	p-value	R sq.
random walk	0.70	<.0001	0.45
AR 1	0.27	0.009	0.56
bivariate	0.75	<.0001	0.84

λ_{avrg}=0.57 R^2_{avrg}=0.62

Spain

	lambda	p-value	R sq.
random walk	0.67	<.0001	0.56
AR 1	0.70	<.0001	0.16
bivariate	1.00	<.0001	0.82

λ_{avrg}=0.79 R^2_{avrg}=0.51

λ_{avrg}EMU=0.62
R^2_{avrg}EMU=0.54

Table A13. **Risk Sharing Parameter Estimates – CC, H_0: λ=0**

Czech Republic-EMU

	lambda	p-value	R sq.
random walk	0.92	<.0001	0.47
AR 1	0.85	<.0001	0.50
Bivariate	1.13	0.0001	0.48

λ_{avrg}=0.97 R^2_{avrg}=0.48

Estonia-EMU

	lambda	p-value	R sq.
random walk	0.78	<.0001	0.50
AR 1	1.01	<.0001	0.02
Bivariate	0.85	0.006	0.36

λ_{avrg}=0.88 R^2_{avrg}=0.29

Hungary-EMU

	lambda	p-value	R sq.
random walk	0.85	<.0001	0.84
AR 1	0.73	<.0001	0.53
Bivariate	1.17	<.0001	0.48

λ_{avrg}=0.92 R^2_{avrg}=0.62

Latvia-EMU

	lambda	p-value	R sq.
random walk	0.78	<.0001	0.26
AR 1	0.44	<.0001	0.38
Bivariate	0.89	0.083	0.18

λ_{avrg}=0.70 R^2_{avrg}=0.27

Lithuania-EMU

	lambda	p-value	R sq.
random walk	1.00	<.0001	0.04
AR 1	1.02	<.0001	0.31
Bivariate	1.10	0.003	0.05

λ_{avrg}=1.04 R^2_{avrg}=0.13

Malta-EMU

	lambda	p-value	R sq.
random walk	0.43	<.0001	0.22
AR 1	0.15	0.261	0.07
bivariate	-0.21	0.44	0.28

λ_{avrg}=0.12 R^2_{avrg}=0.19

Poland-EMU

	lambda	p-value	R sq.
random walk	-0.14	0.443	0.03
AR 1	0.99	<.0001	0.28
bivariate	0.03	0.907	0.07

λ_{avrg}=0.29 R^2_{avrg}=0.13

Slovakia-EMU

	lambda	p-value	R sq.
random walk	0.73	<.0001	0.57
AR 1	0.70	<.0001	0.48
bivariate	0.70	<.0001	0.43

λ_{avrg}=0.71 R^2_{avrg}=0.49

Slovenia-EMU

	lambda	p-value	R sq.
random walk	0.92	<.0001	0.84
AR 1	0.98	<.0001	0.87
bivariate	1.11	<.0001	0.85

λ_{avrg}=1.00 R^2_{avrg}=0.85

λ_{avrg}CC-EMU=0.74

R^2_{avrg}CC-EMU=0.33

Table A14 **Risk Sharing Between EMU Countries and the CC Region, H_0: λ=0**

Austria-CC	lambda	p-value	R sq.
random walk	0.32	0.007	0.42
AR 1	0.18	0.051	0.51
Bivariate	0.11	0.32	0.76

λ_{avrg}=0.20 R^2_{avrg}=0.56

Ireland-CC	lambda	p-value	R sq.
random walk	0.47	0.020	0.32
AR 1	0.55	0.027	0.21
bivariate	0.11	0.59	0.27

λ_{avrg}=0.38 R^2_{avrg}=0.27

Belgium-CC	lambda	p-value	R sq.
random walk	0.47	<.0001	0.10
AR 1	0.23	0.004	0.5
Bivariate	0.30	0.002	0.46

λ_{avrg}=0.33 R^2_{avrg}=0.35

Italy-CC	lambda	p-value	R sq.
random walk	0.17	0.017	0.06
AR 1	0.08	0.091	0.53
bivariate	0.07	0.42	0.03

λ_{avrg}=0.11 R^2_{avrg}0.21

Finland-CC	lambda	p-value	R sq.
random walk	0.29	0.001	0.50
AR 1	0.21	0.017	0.48
Bivariate	0.22	0.071	0.21

λ_{avrg}=0.24 R^2_{avrg}=0.40

Netherlands-CC	lambda	p-value	R sq.
random walk	0.27	0.001	0.29
AR 1	0.19	0.001	0.58
bivariate	0.22	0.016	0.28

λ_{avrg}=0.226667 R^2_{avrg}=0.38

France-CC	lambda	p-value	R sq.
random walk	0.28	0.001	0.32
AR 1	0.16	0.026	0.47
Bivariate	0.21	0.035	0.10

λ_{avrg}=0.22 R^2_{avrg}= 0.30

Portugal-CC	lambda	p-value	R sq.
random walk	0.21	0.007	0.11
AR 1	0.14	0.013	0.55
bivariate	0.15	0.081	0.17

λ_{avrg}=0.17 R^2_{avrg}=0.28

Germany-CC	lambda	p-value	R sq.
random walk	0.27	0.001	0.21
AR 1	0.15	0.007	0.55
Bivariate	0.23	0.003	0.72

λ_{avrg}=0.22 R^2_{avrg}=0.49

Spain-CC	lambda	p-value	R sq.
random walk	0.21	0.011	0.29
AR 1	0.30	0.004	0.20
bivariate	0.27	0.016	0.17

λ_{avrg}=0.26 R^2_{avrg}=0.22

Greece-CC	lambda	p-value	R sq.
random walk	0.16	0.034	0.59
AR 1	0.14	0.024	0.21
Bivariate	0.18	0.092	0.33

λ_{avrg}=0.16 R^2_{avrg}=0.38

λ_{avrg}CC-EMU=0.23

R^2_{avrg}CC-EMU=0.35

Table A15 **Risk Sharing between CC countries and the EMU region, H_0: λ=0**

Czech Republic-EMU	lambda	p-value	R sq.
random walk	0.92	<.0001	0.47
AR 1	0.85	<.0001	0.50
Bivariate	1.13	0.0001	0.48

λ_{avrg}=0.97 R^2_{avrg}=0.48

Malta-EMU	lambda	p-value	R sq.
random walk	0.43	<.0001	0.22
AR 1	0.15	0.261	0.07
bivariate	-0.21	0.44	0.28

λ_{avrg}=0.12 R^2_{avrg}=0.19

Estonia-EMU	lambda	p-value	R sq.
random walk	0.78	<.0001	0.50
AR 1	1.01	<.0001	0.02
Bivariate	0.85	0.006	0.36

λ_{avrg}=0.88 R^2_{avrg}=0.29

Poland-EMU	lambda	p-value	R sq.
random walk	-0.14	0.443	0.03
AR 1	0.99	<.0001	0.28
bivariate	0.03	0.907	0.07

λ_{avrg}=0.29 R^2_{avrg}=0.13

Hungary-EMU	lambda	p-value	R sq.
random walk	0.85	<.0001	0.84
AR 1	0.73	<.0001	0.53
Bivariate	1.17	<.0001	0.48

λ_{avrg}=0.92 R^2_{avrg}=0.62

Slovakia-EMU	lambda	p-value	R sq.
random walk	0.73	<.0001	0.57
AR 1	0.70	<.0001	0.48
bivariate	0.70	<.0001	0.43

λ_{avrg}=0.71 R^2_{avrg}=0.49

Latvia-EMU	Lambda	p-value	R sq.
random walk	0.78	<.0001	0.26
AR 1	0.44	<.0001	0.38
Bivariate	0.89	0.083	0.18

λ_{avrg}=0.70 R^2_{avrg}=0.27

Slovenia-EMU	lambda	p-value	R sq.
random walk	0.92	<.0001	0.84
AR 1	0.98	<.0001	0.87
bivariate	1.11	<.0001	0.85

λ_{avrg}=1.00 R^2_{avrg}=0.85

Lithuania-EMU	Lambda	p-value	R sq.
random walk	1.00	<.0001	0.04
AR 1	1.02	<.0001	0.31
Bivariate	1.10	0.003	0.05

λ_{avrg}=1.04 R^2_{avrg}=0.13

λ_{avrg}CC-EMU=0.74

R^2_{avrg}CC-EMU= 0.33

ABSTRACT

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Consumption Risk Sharing in the European Monetary Union and Candidate Countries

Dissertation directed by Dominick Salvatore, PhD

This paper proposes to evaluate the potential contribution of a monetary union with regards to achieving fuller degree of consumption risk insurance. I conduct empirical test of the hypothesis of consumption risk sharing using two models and two sets of countries: one - the core members of the European Monetary Union (EMU), and the second united simply by their status as countries candidates (CC) to join the EU in 2004. I find support for the null hypothesis of complete consumption risk sharing more often for the EMU countries than for CC countries and observe larger number of rejections over longer cycles than over shorter ones. Using the second model I find that the average degree of risk sharing among EMU countries is up to 1.5 times larger than that for CC countries. These results lend support to the proposition that members of an economic and monetary union can achieve higher level of risk diversification and sharing compared to countries lacking such close economic ties. Finally, I find that EMU members share risk with nonmembers at a much lower level, while the CC group has better consumption risk sharing with the EMU compared to the one within its own group.

With this I conclude that both EMU and CC countries will gain in consumption risk sharing when the union is enlarged.

VITA

Gergana Zlateva Elghouayel, daughter of Peter and Valentina Zlatev, was born on September 12, 1971, in Varna, Bulgaria. After graduating in 1990 from the Lycee for Classical Languages and Cultures in Sofia, Bulgaria she entered Sofia University Law School and 2 years latter transferred to Southern Illinois University (SIU) at Carbondale, IL, USA as the recipient of a NAFSA grant. She graduated in 1994 with Bachelor of Arts in Political Science. In 1996 she earned her Master of Public Administration with a 4.0 GPA from the same university.

In 1996 Gergana won a project grant from the Winston Foundation for World Peace, which sponsored her internship in the United Nations Development Programme (UNDP) in New York. Later that year Gergana was hired as a Program Manager for the Regional Bureau for Europe and the CIS of UNDP where she worked until 1998 when she moved to Moscow, the Russian Federation. In Russia she worked as a Program Manager for the United Nations Educational, Scientific and Cultural Organization (UNESCO) and held consulting positions for several UN agencies, including UNDP-Russia and the International Labor Organization (ILO).

In August 2000 Gergana moved back to New York to start her doctoral degree in Economics at Fordham University. During her time at Fordham, she was awarded a University Scholarship and worked at the Economics Tutoring Center as a tutor and later on as a head of the Tutoring Center. While working on her dissertation under the mentorship of Dr. Dominick Salvatore, in August 2003 she was offered a position as health economist at the World Wide Outcomes Research department of Pfizer Inc.