April 2008
IMF Country Report No. 08/140

Republic of Lithuania: Selected Issues

This Selected Issues paper for the Republic of Lithuania was prepared by a staff team of the International Monetary Fund as background documentation for the periodic consultation with the member country. It is based on the information available at the time it was completed on April 1, 2008. The views expressed in this document are those of the staff team and do not necessarily reflect the views of the government of Germany or the Executive Board of the IMF.

Copies of this report are available to the public from

International Monetary Fund ● Publication Services
700 19th Street, N.W. ● Washington, D.C. 20431
Telephone: (202) 623-7430 ● Telefax: (202) 623-7201
E-mail: publications@imf.org ● Internet: http://www.imf.org

Price: $18.00 a copy

International Monetary Fund
Washington, D.C.

INTERNATIONAL MONETARY FUND

REPUBLIC OF LITHUANIA

Selected Issues

Prepared by Franziska Ohnsorge and Kingsley Obiora (EUR)

Approved by the European Department

April 1, 2008

Contents Page

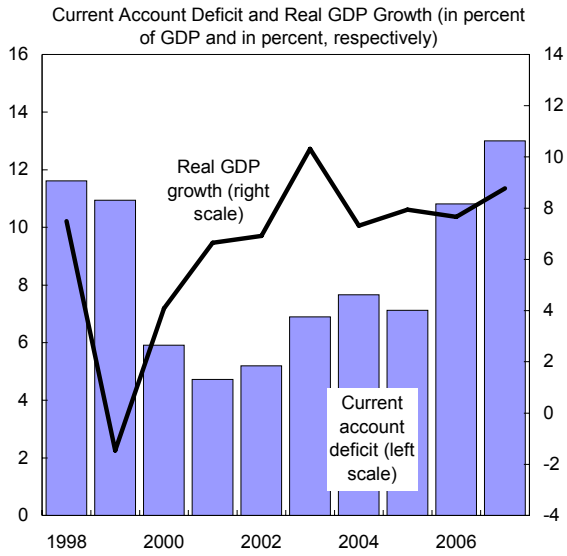
Contents Page

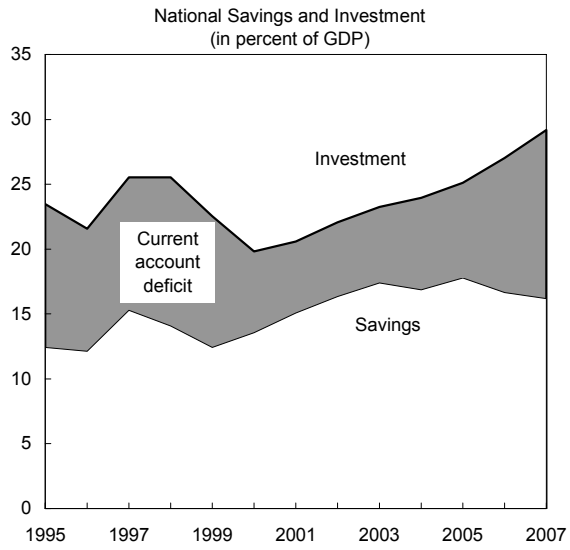
Figures

I. Methodologies for Current Account Assessment

A. Introduction

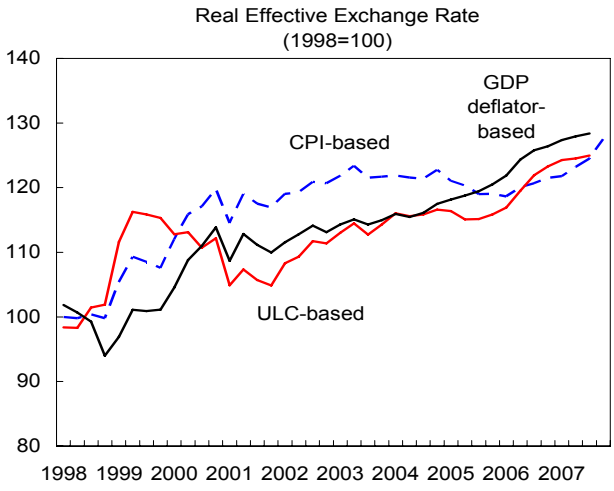
1. **The current account deficit has returned to levels last seen in the late 1990s**. Following the Russia crisis in 1998, investment as a share of GDP fell sharply, leading to a narrowing of the current account deficit from 11½ percent of GDP in 1998 to 4¾ percent of GDP in 2001. Since then, the investment ratio has risen, supported by EU accession, generally sound macroeconomic policies, and the inflow of EU funds. As the saving ratio has remained roughly flat, the current account deficit increased.[1]





Sources: Bank of Lithuania; Statistics Lithuania; and IMF staff estimates.

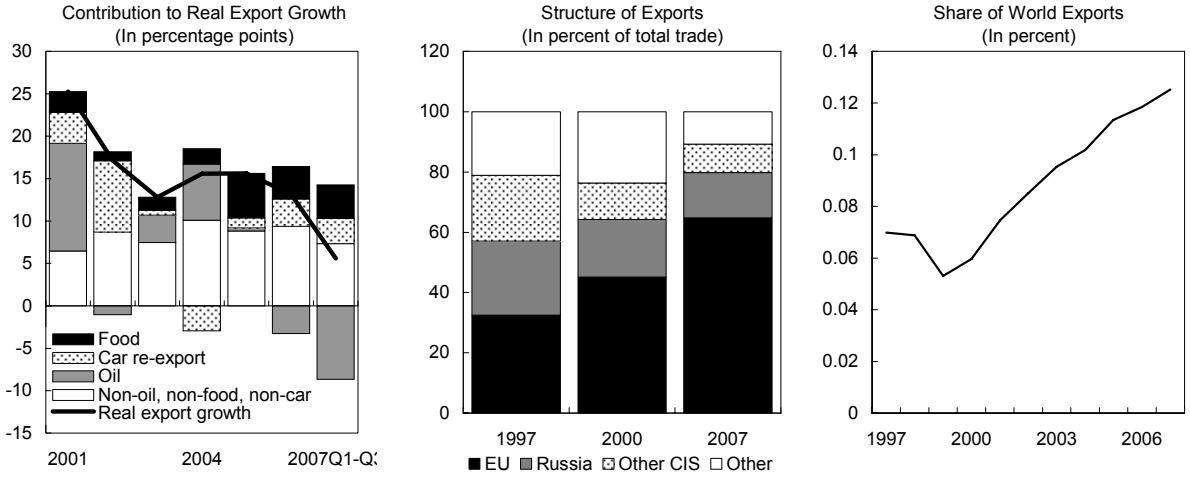
2. **Notwithstanding the appreciation of the real effective exchange rate over the past decade, export growth has been strong.** While the CPI-, ULC-, and GDP deflator-based real effective exchange rates show slightly different patterns, they are all now more appreciated than a decade ago. Nonetheless, Lithuanian exporters have steadily gained market share in world markets. Exports benefited from EU



Source: Eurostat.

[1] The narrowing of the current account deficit in 2005 reflected a surge in current transfers due to EU funds. The trade balance worsened in 2005 by ¼ percentage point of GDP.

accession in 2004, which facilitated a reorientation of trade from Commonwealth of Independent States (CIS) countries to EU member countries. Even excluding processed trade (mostly oil and cars) and agriculture, export growth was rapid. Oil refining contributed significantly to real export growth until production reached capacity in 2004. In 2006 and especially 2007, oil exports fell after production disruptions at the refinery due to a fire. This disruption of oil refining contributed to the widening of the current account deficit.



Source: Department of Statistics; and IMF Direction of Trade Statistics.

3. **This paper examines how the levels of the current account deficit and the real exchange rate in Lithuania compare with estimates of their equilibrium values**. Three different approaches are discussed: the equilibrium real exchange rate approach, the macrobalance approach, and the external sustainability approach. The equilibrium real exchange rate approach directly estimates an equilibrium real exchange rate based on fundamentals that is then compared with the most recent actual real exchange rate. The macrobalance and external sustainability approaches estimate an equilibrium or benchmark current account balance that is compared with the underlying actual current account balance. The real exchange rate overvaluation is the real exchange rate change required to close the resulting gap between underlying and equilibrium balances. The three methodologies provide a wide range of estimates and each methodology suffers from important caveats.

B. The Equilibrium Real Exchange Rate Approach

4. **The ERER approach directly compares the actual real exchange rate (RER) with an equilibrium real exchange rate (ERER) estimated from a cross-country analysis**. The cross-country analysis is based on a panel cointegration regression of CPI-based real exchange rates on fundamental variables (IMF, 2006). The resulting exchange rate assessment is sensitive to the regression specification and the regression sample. The

inclusion of a fixed effect also makes the estimates sensitive to the sample period chosen for Lithuania.

5. **The following variables were found to be important determinants of the ERER**:

- Debtor countries need larger current account surpluses—and, hence, more depreciated real exchange rates—to service their debt. Hence, a 10 percentage point increase in net foreign assets (NFA) as a share of trade appreciates the ERER by ½ percentage point.

- Balassa-Samuelson effect. A 1 percent increase in the productivity differential between tradables and nontradables appreciates the ERER by one-fifth (for a global sample of countries) to one-and-a-half (for a sample of Central and Eastern European countries).

- Real income and wealth effects. A 10 percent increase in the commodity terms of trade appreciates the ERER by 4-5 percent.

- Government consumption tends to fall more on nontradables than on tradables. An increase in government consumption by 1 percentage point of GDP appreciates the ERER by 2½ percent (in the global sample of countries).

- Trade restrictions appreciate the ERER. Price liberalization, concentrated on nontradables, appreciated the ERER especially in the early years of the CEEs' transition.

All variables are measured as deviations from partner countries except for those variables that intrinsically already measure deviation from partner countries (real effective exchange rate, NFA, terms of trade, price controls). The regression also includes country fixed effects that are estimated such that the average in-sample prediction error is zero. It uses annual data for a sample of 48 emerging and industrialized countries for 1980–2004. Lithuania is not included in the sample. The forecast error of the regression is about 12 percent (assuming a 90-percent confidence interval).

Coefficients Estimates for the Equilibrium Real Exchange Rate Approach 1/

	Coefficients	
	Global	CEE-Specific
Fixed effect 2/	1.93	2.77
NFA (as share of average exports and imports)	0.04	0.04
Productivity differential for CEE (logarithm of productivity of tradables minus logarithm of productivity of nontradables, index 2000=100) 3/	0.15	1.42
Commodity terms of trade (logarithm of index 1995=100)	0.46	0.39
Government consumption (as share of GDP) 3/	2.64	0.00
Trade restrictions index (Sachs and Warner, 1995)	0.13	0.14
Price controls (Number of regulated price categories, EBRD)	-0.04	-0.02

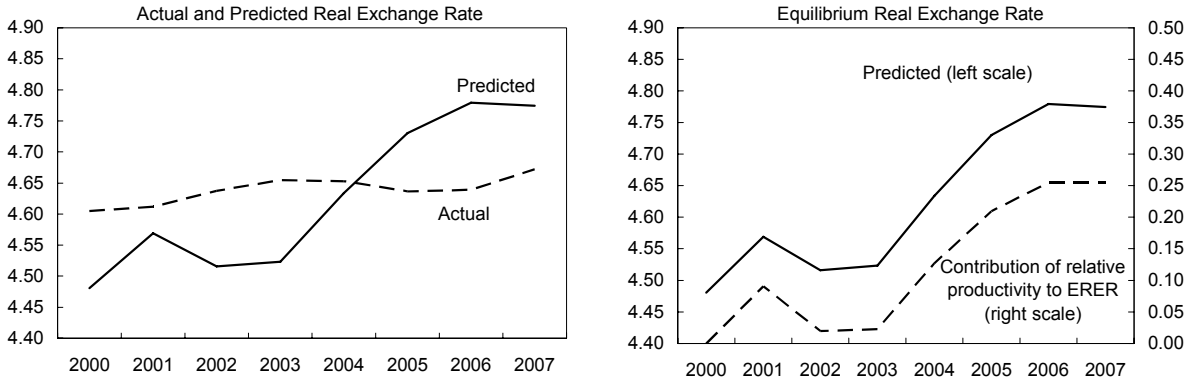
Source: IMF (2006) and subsequent refinements using CEE-specific coefficients.
Note: Fixed effect regression for 48 industrialized and emerging market countries (excl. Lithuania), 1980-2004. CEE are Poland, Slovak and Czech Republics, Hungary, Slovenia.
1/ Dependent Variable: CPI-based real exchange rate from IFS.
2/ Calculated such that the average prediction error (i.e. the average misalignment) for 1997-2004 is zero.
3/ Relative to a trade-weighted average of top nine trade partner countries.

6. **The regression specifications allow for a stronger Balassa-Samuelson effect among the Central and Eastern European countries (CEE) than for the rest of the sample**. The regression is run in two specifications: (i) constraining all countries to have the same coefficients; and (ii) allowing the CEE to have a different coefficient on relative productivity and on government consumption. Among the CEE, a 1 percent increase in the relative productivity of tradables compared with nontradables appreciates the equilibrium real effective exchange rate (ERER) by 1.4 percent. This compares with a 0.15 percent equilibrium real appreciation in the full sample. Since Lithuania's experience is more likely to be similar to the CEE-countries than the global sample, we here choose the CEE-specific regression coefficients for the exchange rate assessment.

7. **The equilibrium RER suggested by these regression coefficients has overestimated Lithuania's actual RER since 2004.**[2] Since 2004, the regression has predicted a more appreciated real exchange rate than the actual real exchange rate. The reason is rapid productivity growth in the tradables sector since EU accession in 2004. In the regression using the CEE-specific coefficients, movements in the relative productivity of tradables are the main source of movements in the equilibrium real exchange rate for Lithuania.

[2] Our calculation uses Lithuania's top nine trading partners (Euro area, Russia, Poland, Latvia, Estonia, Sweden, Denmark, UK, and US). The weights are the same as those used by the EER facility for calculating the CPI-based real effective exchange rate. The nine country groups accounted for 82 percent of Lithuania's trade in 2006.

Equilibrium and Actual Real Exchange Rate
(CPI-based, logarithm of index, 2000=100)



Source: IMF staff estimates.

8. **Relative to nontradables, productivity growth of Lithuanian tradables outpaced that in Lithuania's trading partners by about 20 percentage points between 2000 and 2006**. Since 2000, productivity in Lithuanian tradables has grown more than 30 percentage points more rapidly than productivity in nontradables, as labor moved out of agriculture and into services and construction. In particular, measured agricultural employment fell by almost one-third, which contributed almost 13 percentage points to the increase in the productivity differential between tradables and nontradables. Much agricultural labor has reportedly emigrated. Rapid employment growth in construction accounted for another 9 percentage points of the increase in the productivity differential.

Contribution to Relative Productivity Growth of Tradables
(In percentage points)

	Lithuania	Trading partners
Productivity differential 1/	31.1	11.6
Tradables productivity	57.6	20.7
Output	46.9	13.5
Employment	10.7	7.2
Nontradables productivity	26.4	9.1
Output	38.8	18.2
Employment	-12.4	-9.0

1/ Defined as $\ln(GDP_T)-\ln(Employment_T)$ $-(\ln(GDP_{NT})-\ln(Employment_{NT}))$, 2000-2006.

9. **Using medium-term forecasts as proxies for fundamental values, the ERER coefficient estimates suggest an undervaluation of 9½ percent**. In line with CGER practice, the WEO projections for 2013 are used for the terms of trade and the most recent, 2006, actual value is used for the productivity differential, trade restrictions, and the number of administered price categories defined by the EBRD. Using these values, the equilibrium RER is 9.6 percent higher than the actual RER at end-2007. This estimate is subject to two caveats. First, this assessment is sensitive to the projected constant productivity differential between tradables and nontradables in the medium-term. If a slowdown in the housing market forced a reallocation of labor back into agriculture or other tradables, the productivity differential may shrink. Secondly, the forecast error of 12 percent is large compared with the point estimate. The 90-percent confidence interval of the exchange rate assessment ranges from an undervaluation of up to 22 percent to an overvaluation of 2 percent.

C. The Current Account Gap

10. **Both the macrobalances and the external sustainability approaches compare the underlying current account balance with an equilibrium or benchmark balance**. The *underlying* current account balance is the actual current account balance stripped of temporary factors, the business cycle, and lagged effects of real exchange rate changes. The macrobalances approach defines the *equilibrium* current account balance based on fundamental variables. The link between fundamental macroeconomic variables and the current account balance is established in a panel regression. The external sustainability approach defines the benchmark current account balance as the one that stabilizes NFA at its most recent (end-September 2007) level.

Underlying Balance

11. **The underlying balance can be estimated in a backward-looking or in a forward-looking calculation.** The backward-looking calculation starts with the 2007 actual current account balance and removes temporary factors. The forward-looking calculation starts with the medium-term current account balance and removes changes in policies. As long as medium-term projections are based on the assumption of a zero output gap and a constant REER, the two calculations should yield broadly consistent results.

12. **In the backward-looking calculation, the 2007 current account balance is adjusted for temporary factors, lagged effects of past real exchange rate movements, and—most importantly in Lithuania's case—the business cycle**. A large positive domestic output gap, estimated at 4½ percent of GDP in 2007, has contributed to cyclically high imports on the order of 4¾ percent of GDP. Conversely, a small positive output gap in Lithuania's trading partners has cyclically raised exports in 2007, accounting for a cyclical improvement in the current account balance of 0.4 percent of GDP. Once the CPI-based real exchange rate appreciation of 2005–07 has fed through the system, the underlying balance will likely worsen by 1 percentage point of GDP.

Deriving the Underlying Current Account Balance
(in percent of GDP)

	Adjustment
2007 Current account balance	-13.0
Temporary effects	1.0
Lithuanian business cycle	4.7
Export partners' business cycle	-0.4
Real exchange rate movements	-1.0
in 2007	-1.1
in 2006	-0.1
in 2005	0.3
Underlying current account balance	-8.6

Methodology: Isard and Faruqee (1998), OP167.

13. **The estimate of the underlying balance is sensitive to the assumed export and import elasticities to the output gap and the real exchange rate**. Here, the elasticities from a cross-country sample in Isard and Faruqee (1998) are used. On one hand, the Bank of Lithuania uses lower elasticities in its macro model but, overall, the Bank of Lithuania's set of elasticities yields a similar underlying current account balance. On the other hand,

especially the elasticity of imports to demand pressures may be underestimated by Isard and Faruqee (1998). As the output gap widens, further demand pressures may increasingly spill over into the current account deficit rather than into GDP growth and the elasticity of imports to the output gap may increase. If, say, the elasticity of imports to the output gap was 2 rather than the currently assumed 1.5, the underlying current account balance would be 7¼ percent.

14. **Lithuania-specific factors temporarily worsened the current account deficit in 2007.** First, the temporary production shortfalls of the oil refinery Mazeikiu Nafta are estimated to have worsened the trade balance by 1 percent of GDP in 2007. As a result of the fire at Mazeikiu Nafta and the pipeline shutdown in 2007, mineral exports declined by almost two-fifths in 2007 and imports by just over one-fifth. With mineral exports about 11 percent of GDP and mineral imports about 15 percent of GDP in 2006, this implied a worsening of the net oil balance of about 1 percent of GDP. Second, Lithuania's terms of trade are expected to improve by 1.6 percent over the medium-term. By itself, this may lead to a narrowing in the trade deficit of ¼ percent of GDP. Third, current transfers, especially from the EU, are expected to decline by about ¼ percent of GDP over the medium-term. Although this in itself may worsen the current account balance, it may also reduce transfer-related imports by 0.1 percent of GDP.

Adjustment for Temporary Factors to the Current Account Balance in 2007 (in percent of GDP)

Adjustment for Temporary Effects	1.0
Production shortfall at oil refinery	1.0
Improving terms of trade	0.2
Declining current transfers	-0.1

15. **In the forward-looking calculation, the 2013 projection of the current account balance is adjusted for expected fiscal consolidation**. The cyclically-adjusted general government deficit is estimated at 3¼ percent of GDP in 2007. The fiscal responsibility law is expected to constrain the general government budget to balance in the medium term, implying a fiscal consolidation of 3¼ percent of GDP. Using the pass-through of the fiscal balance to the current account deficit from the panel regression in IMF (2006), i.e., 0.19, this fiscal consolidation is expected to improve the current account balance by just over ½ percentage point of GDP.

Forward-Looking Calculation of the Underlying Current Account Balance in 2007 (in percent of GDP)

	Adjustment
Projected current account balance	-8.0
Adjustment for constant fiscal policy	-0.6
Underlying current account balance 1/	-8.6

1/ Projection needs to assume a zero output gap, no temporary effects, and a constant real exchange rate from the latest data.

Macrobalance Approach

16. **Based on a cross-country regression, the macroeconomic balance approach estimates the current account balance that would be in line with fundamentals**. Two such regressions have recently been used, with similar fundamental variables but different samples: the standard CGER approach (IMF, 2006) and one that puts more emphasis on the convergence process in European countries (Abiad et al., 2007).

17. **The standard CGER methodology uses a consistent approach to assess the current account deficits of a wide range of countries.** The pooled OLS regression uses data for 54 industrialized and emerging markets for non-overlapping four-year averages during the period 1973–2004 (IMF, 2006). The following fundamental macroeconomic variables are included.

- Ricardian equivalence—where changes in private savings fully offset changes in public savings—is well-known not to hold. Hence, an increase in the general government deficit by 10 percentage points of GDP increases the equilibrium current account deficit by 1.9 percentage points of GDP.

- A more economically active population increases national savings. Hence, a 1 percentage point increase in the dependency ratio raises the equilibrium current account deficit by one-tenth percentage point of GDP. An increase in population growth by 1 percentage point raises the current account deficit by 1 percentage point of GDP.

Macrobalance Approach using CGER Coefficients

	Coefficients
Fiscal balance 1/	0.189
Old-age dependency ratio 1/	-0.123
Population growth 1/	-1.028
Oil balance	0.169
Output growth 1/	-0.157
Relative income 2/	0.020
Lagged dependent variable	0.366
Constant	-0.003

Source: IMF (2006).
1/ Relative to weighted average of trading partners.
2/ Relative to US.

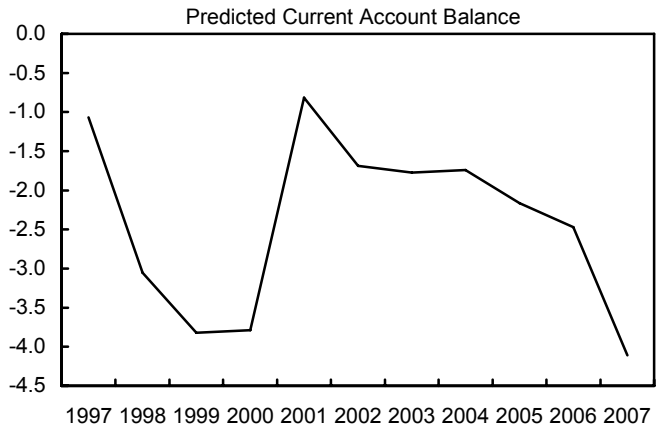
- The oil balance captures country-specific effects of oil price fluctuations. A 1 percentage point of GDP improvement in the oil balance reduces the current account deficit by one-fifth percentage point of GDP.

- Economic growth and the stage of economic development capture intertemporal considerations, such as investment catchup. A 1 percentage point increase in real GDP growth per capita raises the current account deficit by one-fifth percentage point of GDP. A 10 percentage point increase in income relative to the U.S. reduces the current account deficit by one-fifth percentage point of GDP.

- The lagged current account deficit proxies stock variables, such as NFA, and captures strong persistence in the current account.

Again, all variables are calculated as deviations from trading partner averages with the exception of those variables that already intrinsically capture deviations from trading partners (current account balance, NFA and oil balance). The regressions' forecast error is 2−3½ percentage points of GDP (based on the 90 percent confidence level).

18. Historically, the level of the equilibrium current account balance mostly reflects the lagged current account deficit. In addition, the equilibrium current account balance improved with the fiscal balance until 2003 and then began to deteriorate as the general government deficit (including restitution payments) widened. Since EU accession, rapid real GDP growth and a slowing decline in population growth compared with Lithuania's trading partners added to the widening equilibrium current account balance.



Source: IMF staff estimates.

19. **The regression coefficients suggest an equilibrium current account deficit of 2½ percent of GDP based on medium-term projections**. Again, the 2013 WEO projections, supplemented with medium-term UN population projections, are used as medium-term equilibrium values for the fundamental macroeconomic variables. The projected narrowing of the current account deficit between 2007 and 2013 is what primarily drives the decline from the predicted current account deficit of 4 percent of GDP in 2007 to the medium-term equilibrium level of 2½ percent of GDP. Given the forecast errors for the 90 percent confidence level, the equilibrium current account balance can range between a deficit of 5½ percent of GDP to a surplus of 1½ percent of GDP.

20. **Abiad and others (2007) attempt to capture the financial deepening that has been especially important in the EU.** Over the past 30 years, European countries have rapidly expanded their trade and financial links. Rapid financial deepening has provided financing for wide current account deficits in the convergence process. In addition to a financial deepening variable, Abiad and others (2007) include the standard variables, such as per capita GDP, real GDP growth, the fiscal balance, dependency ratios, and trade openness. In a broad sample of countries, they find that the usual variables have broadly the expected signs and that financial integration is insignificant. Once they restrict the sample to EU countries, however, their results differ sharply**.** The standard variables become mostly

Macrobalance Approach using Coefficients from Abiad et al (2007)
(in percent of GDP)

	Coefficients
GDP per capita	-0.008
Growth in GDP per capita	0.004
General government balance	-0.119
Net foreign assets	-0.028
Old dependency ratio	-0.292
Young dependency ratio	-0.018
Trade openness	-0.014
Financial integration	-0.430
(GDP per capita)*(Financial integration)	0.045
Constant	0.137
Year dummy 2013 1/	-0.088

Source: Abiad, Mody, and Leigh (2007).
1/ Calculated such that average prediction error over all 23 EU countries in the sample in 2013 is zero.

insignificant while financial integration becomes the main determinant of the current account balance. In the broader sample, income convergence widens current account deficits in a general way. In the EU sample, however, income convergence widens the current account deficit through the channel of financial integration. Controlling for financial deepening, rapid GDP growth tends to *narrow* the current account deficit. This suggests that financial integration is capturing the effect of domestic demand-driven growth on the current account, while the coefficient on GDP growth itself reflects the effect of export-led growth on the current account deficit. Given Lithuania's financial integration with the rest of Europe, a 10 percent increase in Lithuania's GDP per capita reduces the current account deficit by ¾ percent of GDP. These estimates may better reflect the convergence process in Lithuania than the estimates based on IMF (2006).

21. **The regression coefficients by Abiad and others (2007) imply an equilibrium current account deficit of 4¾ percent of GDP.**[3] Again, the 2013 WEO projections are used as medium-term values. By far the most important determinant of the equilibrium balance is Lithuania's financial integration (including the interaction with GDP per capita). The process of financial deepening alone accounts for 5¼ percent of GDP of the equilibrium current account balance.

Equilibrium Current Account Balance in Macrobalance
Macrobalance Approach using Coefficients from Abiad et al (2007)
(in percent of GDP)

	Contributions of deviations
GDP per capita	0.2
Growth in GDP per capita	1.2
General government balance	-0.1
Net foreign assets	1.6
Old dependency ratio	0.3
Young dependency ratio	0.0
Trade openness	-0.1
Financial integration (incl. interaction with GDP per capita)	-5.3
Year dummy 2013 1/	-2.8

Source: Abiad, Mody, and Leigh (2007).
1/ Calculated such that average prediction error over all 23 EU countries in the sample in 2013 is zero.

External Sustainability Approach

22. **The external sustainability approach determines the current account balance that would be consistent with an unchanged stock of net foreign assets**. The following relationship defines the NFA-stabilizing current account balance:

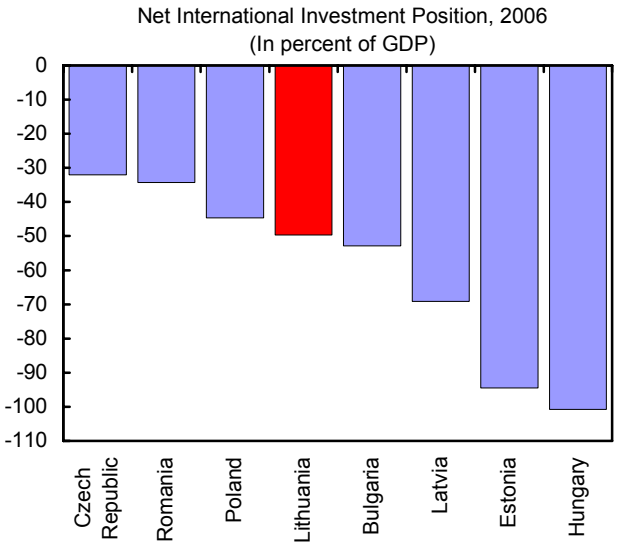
$$\mathrm{CAB} = \frac{\mathrm{g} + \pi}{(1+\pi)(1+\mathrm{g})}\,\mathrm{NFA}\,,$$

[3] For consistency with IMF (2006), the contributions are shown in deviations from the mean.

where CAB = NFA-stabilizing current account balance
g = real GDP growth rate
π = inflation rate

23. The standard CGER approach is to use the most recently available net IIP position (i.e., at end-September 2007). The growth rate is evaluated at potential output growth in the medium-term (5¾ percent) and inflation at U.S. inflation in the medium term (2¼ percent). A refinement of this approach allows for different interest rates on assets and liabilities (Appendix). This is especially relevant for Lithuania with a substantial stock of foreign assets (43 percent of GDP).

24. **Lithuania's net international investment position is broadly in line with other Central and Eastern European countries.** Lithuania's net international liabilities at end-September 2007 were 53¾ percent of GDP, with international assets of about 41½ percent of GDP (Table 1). About two-thirds of international liabilities and nine-tenths of international assets were held in debt. Two-fifths of international liabilities were either FDI or equity.



Source: IMF, International Financial Statistics.

25. **The current account balance that stabilizes NFA at its end-September 2007 level is 4 percent of GDP.** Rapid nominal GDP growth allows Lithuania to "outgrow" its net international liabilities of about half of GDP. On this account, Lithuania could be running a trade deficit of about 4 percent of GDP.

NFA-Stabilizing Current Account Balance in External Sustainability Approach

Variable	Sep-07
Benchmark level of NFA (in percent of GDP)	-53.7
g Real GDP growth (in percent)	5.8
π Inflation (in percent)	2.3
NFA stabilizing current account balance (in percent of GDP	-4.0

Source: Milesi Feretti (2006) and IMF (2006).

Real Exchange Rate Assessment Based on the Current Account Gap

26. **The gap between underlying and equilibrium or benchmark current account balances is partly closed by factors that are insensitive to real exchange rate movements**. Larger current account deficits can be sustained in the medium-term if they are financed by capital transfers, for example due to EU funds or migrants' transfers. In Lithuania's case, medium-term capital transfers amount to about 1½ percent of GDP.

27. **The remaining gap may eventually have to be closed by real exchange rate movements.** To obtain the required real depreciation, we use elasticities of imports and exports to the real exchange rate from a cross country study (IMF, 1998), 0.92 and -0.71, respectively. Applying these elasticities, the real exchange rate would need to depreciate by 7–9 percent to close the current account gaps.

Current Account Balance Gap and Real Exchange Rate Overvaluation in Macrobalances and External Sustainability Approaches
(in percent of GDP, unless otherwise specified)

	Macrobalance Approach	External Sustainability Approach
Macrobalances Approach		
Equilibrium balance A	-4.8	-4.0
Underlying balance B	-8.6	-8.6
Gap = A-B	**3.9**	**4.6**
Mitigating factor C: capital transfers	1.5	1.5
Gap net of mitigating factors = A-B-C	**2.4**	**3.1**
Overvaluation (in percent) =(Gap-C)/D	6.9	9.0
Memorandum item:		
Elasticity of net exports to REER D 1/	-0.3	-0.3

1/ Elasticities based on Isard and Faruqee (1998).

D. Conclusions

28. **Estimates of real exchange rate overvaluation and current account gaps vary widely and are subject to large uncertainties.** The regression-based estimates (ERER and macrobalance approaches) are sensitive to the regression specifications and samples that determine equilibrium values. The forecast errors of the regressions are large compared to the point estimates for Lithuania. For example, the actual real exchange rate is within one standard deviation of its equilibrium value. The two current account gap-based approaches (macrobalance and external sustainability approaches) require in addition the estimation of an underlying current account balance that depends on the estimated size of the output gap, which itself is subject to much uncertainty, and on uncertain and probably state-dependent import and export elasticities to real exchange rate movements and the business cycle.

29. **However, a large current account deficit—even if not far from its equilibrium value—still poses risks**. The large current account deficit in Lithuania may well be the equilibrium outcome of rapid income catch-up driven by strong fundamentals, including EU accession. But the need to finance such a large current account deficit also increases vulnerability to contagion from global financial markets.

Table 1. Lithuania: Net International Investment Position, 2002-07
(in percent of GDP)

	2002	2003	2004	2005	2006	2007Q3
Lithuania	-32.8	-33.4	-34.6	-43.2	-49.7	-53.7
Assets	26.9	27.8	30.0	37.2	43.2	41.6
Of which: short-term	20.9	22.0	21.6	24.0	27.7	25.0
Liabilities	59.7	61.1	64.6	80.4	92.9	95.2
Of which: short-term	12.2	14.7	14.9	19.6	17.9	16.5
Government and Monetary Authorities 1/	1.7	4.0	2.6	4.4	5.8	5.8
Assets	15.4	16.8	14.6	15.6	18.6	16.8
Of which: short-term	15.4	16.8	14.6	15.6	18.5	16.8
Liabilities	13.7	12.8	12.0	11.2	12.8	11.0
Of which: short-term	0.0	0.2	0.3	0.4	0.3	0.0
Corporates	-28.0	-28.3	-28.7	-32.6	-35.0	-34.0
Assets	6.8	6.4	7.8	10.8	11.9	13.1
Of which: short-term	1.6	1.4	1.1	0.9	1.0	0.9
FDI	0.4	0.5	1.7	2.4	2.8	3.2
Liabilities	34.8	34.7	36.5	43.5	47.0	47.2
Of which: short-term	7.9	7.7	7.7	8.6	7.6	7.1
FDI	20.3	20.3	22.1	29.4	29.7	29.4
Banks	-6.6	-9.0	-8.5	-14.9	-20.5	-25.5
Assets	4.7	4.6	7.6	10.8	12.7	11.7
Of which: parent banks			...		10.1	11.8	11.0
Short-term	3.9	3.8	6.0	7.5	8.3	7.4
FDI	0.0	0.0	0.1	0.6	0.6	0.5
Liabilities	11.3	13.6	16.1	25.7	33.2	37.1
Of which: parent banks		5.4	6.5	13.2	17.3	19.6
Short-term	4.3	6.8	7.0	10.6	10.0	9.3
FDI	5.1	3.8	3.7	4.1	5.6	6.0

Sources: Bank of Lithuania, and IMF staff estimates.
1/ All reserves attributed to monetary authorities.

APPENDIX I. EXTERNAL SUSTAINABILITY APPROACH ALLOWING FOR INTEREST PAYMENTS

By focusing on the trade balance, the financing cost—varying for assets and liabilities—can be taken into account in calculating the NFA-stabilizing balance. The following relationship defines the NFA-stabilizing trade balance[4]:

$$TB = -\frac{(i^{EA} - n)}{(1+n)} A^{E} - \frac{(i^{DA} - n)}{(1+n)} A^{D} + \frac{(i^{EL} - n)}{(1+n)} L^{E} + \frac{(i^{DL} - n)}{(1+n)} L^{D},$$

where TB = NFA-stabilizing trade balance
n = nominal GDP growth
i^{EA} = interest on equity assets
i^{DA} = interest on debt assets
i^{EL} = interest on equity liabilities
i^{DL} = interest on debt liabilities
A^{E} = stock of equity assets (in percent of GDP)
A^{D} = stock of debt assets (in percent of GDP)
L^{E} = stock of equity liabilities (in percent of GDP)
LD = stock of debt liabilities (in percent of GDP)

The interest rate on debt is assumed to be 6 percent, with a spread of 100 basis points for liabilities. The interest rate on equity is assumed to be real GDP growth (Lithuanian for Lithuanian assets and world growth for foreign assets) plus medium-term US inflation plus an spread of 100 basis points on liabilities. Nominal GDP growth is chosen at its projected medium-term, 2013, value.

The trade deficit that stabilizes NFA at its end-2006 level is about ¾ percent of GDP. This is the result of three offsetting factors.

- First, rapid nominal GDP growth of about 10¼ percent allows Lithuania to "outgrow" its net international liabilities of about half of GDP. On this account alone, Lithuania could be running a trade deficit of about 5½ percent of GDP.
- Second, interest due on Lithuania's net international liabilities, at a rate of 7¾ percent on average, needs to be financed. This by itself should require trade surpluses of 4 percent of GDP.

[4] The relevant "trade balance" is the part of the current account balance that is not related to income payments on external assets and liabilities and that is not financed by capital transfers. Hence, it includes the conventional trade balance, the labor income balance, the current transfer balance, and the capital account balance. IMF (2006), p. 19, calls it the "trade balance inclusive of services and transfers".

- Third, Lithuania makes a net interest loss of about 1½ percent on its international assets compared to its international liabilities. With international assets amounting to almost half of GDP, by itself this net interest loss would have to be financed by a trade surplus of about ¾ percent of GDP.

Net, these three factors yield an NFA-stabilizing trade deficit of ¾ percent of GDP.

Equilibrium Trade Balance
in External Sustainability Approach

Variable	Sep-07
Benchmark level of NFA (in percent of GDP)	-53.7
n Nominal GDP growth (in percent)	10.2
i^{EA} interest on equity assets (in percent)	8.4
i^{EL} interest on equity liabilities (in percent)	9.1
i^{DA} interest on debt assets (in percent)	6.0
i^{DL} interest on debt liabilities (in percent)	7.0
A^{E} Equity assets (in percent of GDP)	4.6
A^{D} Debt assets (in percent of GDP)	38.4
L^{E} Equity liabilities (in percent of GDP)	33.1
L^{D} Debt liabilities (in percent of GDP)	65.5
TB NFA stabilizing trade balance (in percent of GDP)	-0.7

Source: Milesi Feretti (2006) and IMF (2006).

This equilibrium trade balance, after adjustments, is about 3¾ percent of GDP narrower than the actual trade balance in 2007. The underlying trade balance is obtained with the same adjustments as the underlying current account balance. The trade balance for 2007 was about 11½ percent of GDP, implying an underlying trade balance of about 7¼ percent of GDP. The gap between the equilibrium and the underlying trade balance is, hence, 6½ percent of GDP. Again, this gap can partly be financed by medium-term capital transfers of 1½ percent of GDP. In addition, larger trade deficits can be sustained without a real exchange rate depreciation if they are financed by long-term current transfers (about 2¾ percent of GDP in 2013) or by long-term worker remittances reflected in the income balance (about ½ percent of GDP in 2013). The resulting gap, net of mitigating factors is therefore just under 2 percent of GDP, implying a real exchange rate overvaluation of 5½ percent.

REFERENCES

IMF, 2006, "Methodology for CGER Exchange Rate Assessments", available at http://www.imf.org/external/np/pp/eng/2006/110806.pdf.

Isard, Peter, and Hamid Faruqee, 1998, "Exchange Rate Assessment—Extensions of the Macroeconomic Balance Approach", IMF Occasional Paper No. 167.

Abiad, Abdul, Daniel Leigh, and Ashoka Mody, 2007, "International Finance and Income Convergence: Europe is Different," IMF Working Paper No. 07/64.

II. Estimating the Output Gap in Lithuania

A. Introduction

30. **Macroeconomic developments in Lithuania suggest a widening of the output gap in recent years.** The current account deficit widened from nearly 7 percent of GDP in 2003 to 13 percent in 2007, reflecting deteriorations in the goods and services balance, and in net income. Labor markets have also tightened steadily. Real wage growth increased from 6¾ percent at end-2003 to 9¾ percent at end-2007. Inflation also increased, especially among nontradables. While inflation (year-on-year) was 8¼ percent in December 2007, nontradables inflation was 12¼ percent for the same period. Estimates of the output gap can capture these demand pressures in one measure, and provide some guidance on the appropriate stance of macroeconomic policy.

Lithuania: Selected Coincident Indicators, 2002-07

	2002	2003	2004	2005	2006	2007
	In percent, unless otherwise indicated					
CPI inflation (end-period)	-0.9	-1.3	2.8	3.0	4.5	8.2
o/w nontradables	0.6	0.6	3.7	5.6	6.5	12.3
Current account deficit 1/	-5.2	-6.9	-7.7	-7.1	-10.8	-13.0
o/w nonoil balance	-3.3	-3.9	-6.5	-4.4	-6.4	-11.5
Real wage growth (end-period)	6.3	6.8	5.4	7.7	14.3	9.8

Sources: Lithuanian authorities; and IMF staff calculations.
1/ In percent of GDP.

31. **This paper presents various methodologies to estimate the output gap.** In particular, three methodologies are discussed here: a statistical filtering approach (section B), a panel regression approach (section C), and a production function approach (section D). The estimates of the output gap from each methodology are compared with coincident indicators such as inflation, real wage growth, and the trade deficit (section E). Conclusions are presented in section F.

B. The Hodrick-Prescott Filter

32. **The Hodrick-Prescott (HP) filter is a simple and widely-used methodology.** The HP filter estimates potential output by minimizing the difference between actual and potential output while constraining variations in potential growth. Thus, the HP filter minimizes the following:

$$\underset{y_t^*}{Min} \sum_{t=1}^{T} \left(y_t - y_t^*\right)^2 + \lambda \sum_{t=2}^{T-1} \left[\left(y_{t+1}^* - y_t^*\right) - \left(y_t^* - y_{t-1}^*\right)\right]^2 ,$$

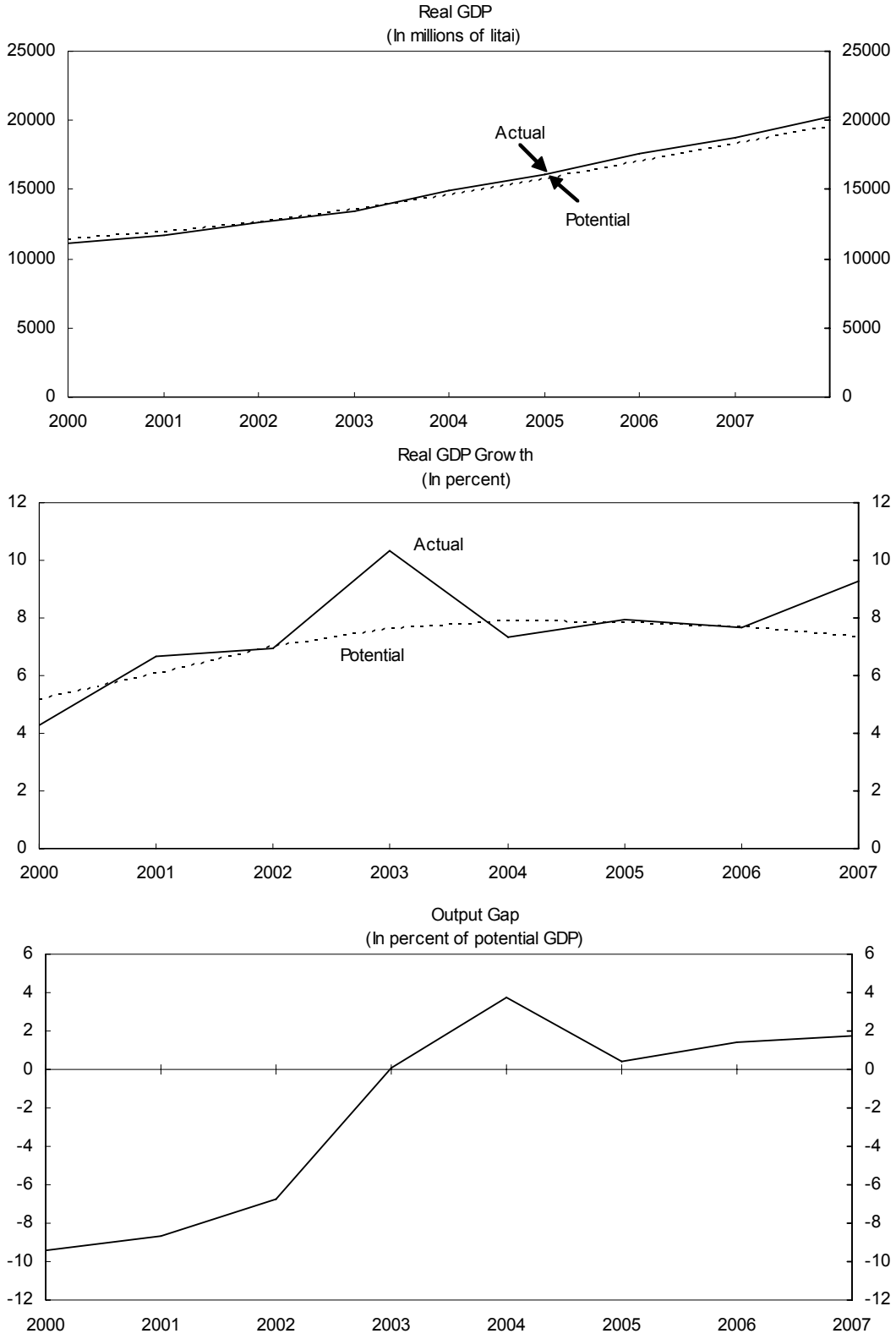
where y is the logarithm of real GDP and y^* is the logarithm of potential real GDP. The exogenously-determined detrending parameter, λ, sets the extent of permissible variations in potential growth, and therefore controls the smoothness of the series. It can assume a value

ranging from zero to infinity. Where λ is infinitely large, the variation in potential growth will be minimal. With a resultant linear trend, the level of potential growth will be constant. Conversely, where λ is zero, there is little difference between actual and potential output resulting in a zero output gap. In general, therefore, λ acts as a penalty on variation, where variation is measured by the average squared second difference. A larger value of λ results in a smoother series (Harvey and Jaeger, 1993). In their analysis of U.S. business cycles, Hodrick and Prescott (1997) proposed a value of 1600 for λ with regard to quarterly data, and this has become common practice. Therefore, we applied λ equals 1600.

33. **The HP filter's minimal data requirements, flexibility, and simplicity make it a popular methodology.** First, unlike theoretical approaches for estimating the output gap, the HP filter requires only data for actual output. This makes it especially suitable for countries where there are data inadequacies or unavailability. Second, the essential characteristics of trend fluctuations can be tracked. Third, the results are easily replicable and allow cross-country comparisons of the output gap. Finally, the HP filter requires few judgmental assumptions and little reliance on economic theory to produce its results.

34. **Using the standard value of the detrending parameter (λ), the estimated output gap for 2007 is 1¾ percent of potential GDP (Figure 1).** Given the volatility of quarterly data, the figures present annual averages. Potential output growth increased from 5¼ percent in 2000 to 7¼ percent in 2007, having reached its highest growth rate of almost 8 percent in 2003 and 2004. For most of the period, potential growth closely followed the movement of actual growth except during the run-up to EU accession in 2003.

Figure 1. Lithuania: Potential GDP Growth Estimated by HP Filter, 2000-07



Source: IMF staff estimates.

35. **Despite the advantages of the HP filter, the methodology has three important weaknesses.** First, the HP filter uses a two-sided filtering procedure. Therefore, the HP filter is subject to end-sample bias. The HP filter uses both backward and forward information in order to estimate potential output for any given time. However, at the end of the sample, there is only backward information, and then the HP filter tampers into a one-sided filter. In general, therefore, the accuracy of its estimates diminishes at the end of the sample because of missing lead information. This problem is important because the most essential pieces of information for forecasting inflation are usually contained in the recent past. One way to deal with the end-sample bias is to increase the lead information by using forecasts beyond the years that the researcher is interested in. Second, the filter may obtain spurious cyclicality for integrated series and may not recognize structural breaks in time series. Third, the value of λ must be determined before setting out to estimate potential output.

C. Regression Approach

36. **Potential growth can also be estimated by using a panel regression.** Schadler and others (2006) estimated a growth equation for both advanced and emerging market (EM) countries to assess growth prospects. Lithuania was included in the estimation for emerging market countries. The regression uses data from 1984 to 2004 for the following variables: log of per capita GDP, population growth, partner country growth, relative price of investment goods, schooling, openness ratio, government taxation ratio, institutional quality, and institutional quality times log of per capital GDP. The dependent variable is the average growth rate of per capita GDP during five-year non-overlapping periods while data for the explanatory variables are generated using the values of each variable at the end of the previous five year period. Estimation was carried out using the seemingly unrelated regression approach. The results indicate that the key driving forces in explaining growth are the log of per capita GDP and population growth. Other statistically significant variables in the model include partner country growth, relative price of investment goods, and the openness ratio.

Panel Growth Regression Estimates

	Advanced and EM sample	
Explanatory Variable	Coefficient	*t*-statistic
Log of per capita GDP	-2.27	(6.34)
Population growth	-1.27	(7.42)
Partner country growth	0.61	(3.24)
Relative price of investment goods	-0.75	(2.41)
Schooling	0.20	(1.40)
Openness ratio	0.01	(3.85)
Government taxation ratio	-0.02	(1.20)
Institutional quality	0.03	(1.88)
Dummy, 99-04	20.93	(6.74)
Dummy, 94-99	20.31	(6.50)
Dummy, 89-84	20.96	(6.72)
Dummy, 84-89	20.51	(6.50)
Number of observations	191	
R-squared	0.28	

Source: Schadler, et al (2006)

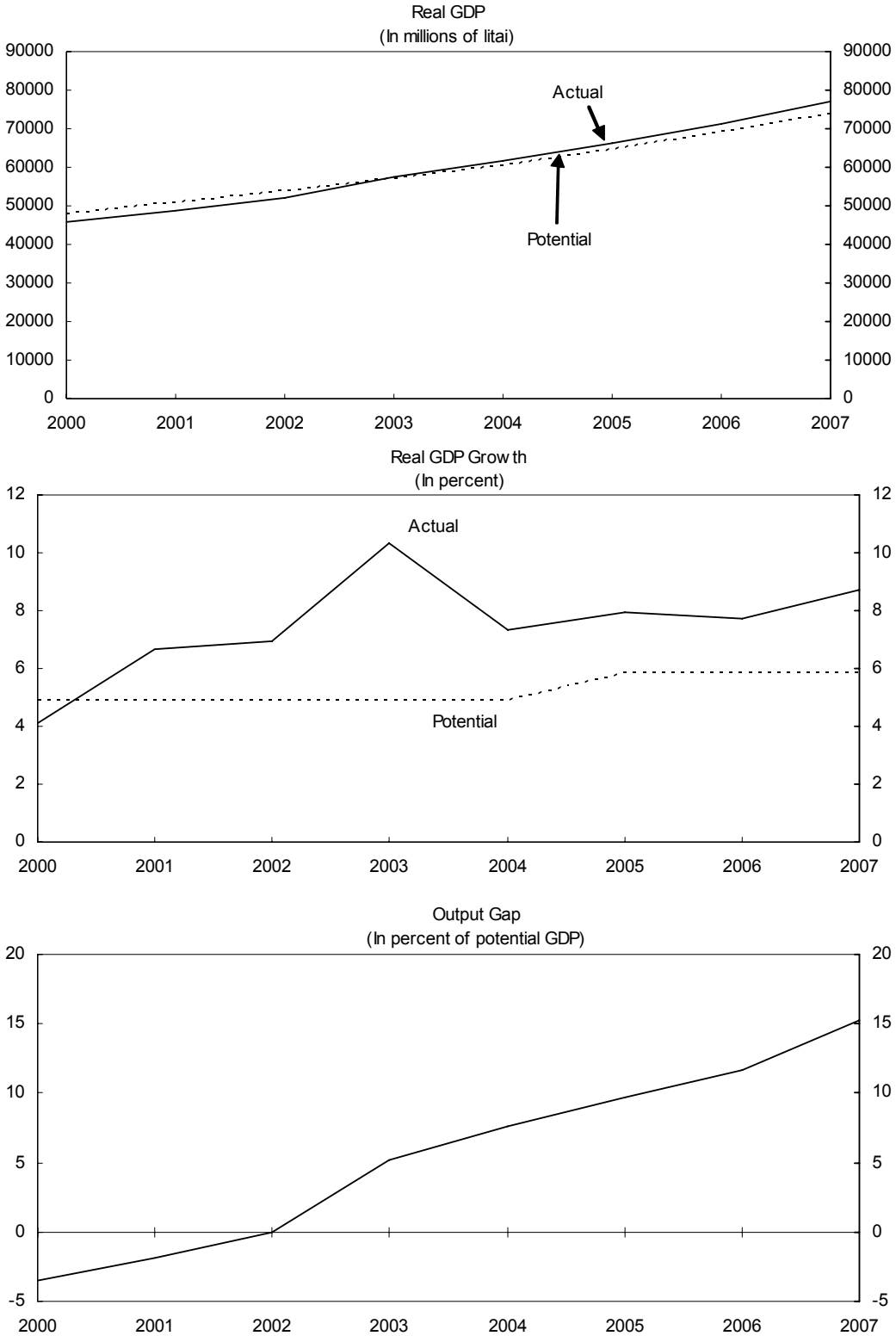
37. **Using the regression coefficients, predicted values can be used as estimates of potential growth rates.** To generate an estimate of potential growth for 2005–09, the panel estimation results are used in the context of the assumption that explanatory variables remain at their 2004 levels. In the case of Lithuania, the estimated potential growth rate for the period 2005–09 is 5¾ percent, up from nearly 5 percent for the preceding period. The regression standard error is 1½ percent around the predicted potential growth rates, while the output gap is estimated to be 15¼ percent in 2007.

Lithuania: Predicted Growth Rates from Panel Regression

Explanatory Variable	1998	2004
Log of per capita GDP	8.9	9.2
Population growth	-0.7	-0.5
Partner country growth	1.7	3.5
Relative price of investment goods	1.5	1.3
Schooling	3.5	3.8
Openness ratio	106.2	111.4
Government taxation ratio	27.9	19.8
Institutional quality	74.0	75.6
	1999-2004	2005-2009
Predicted growth	4.9	5.8

Source: Schadler, et al (2006).

Figure 2. Lithuania: Potential GDP Growth
Estimated using Panel Regression Approach, 2000-07



Sources: Schadler, et al (2006); and IMF staff estimates.

38. **The panel regression approach provides a richer explanation of potential growth but has significant drawbacks.** First, the regression systematically underestimates growth in Lithuania throughout the sample period, casting doubt on potential growth estimates derived from the regression for Lithuania. Second, the magnitude of coefficient estimates is such that the predicted potential growth rate is essentially driven by convergence, with little role for labor market developments or movements in the capital stock (for which the price of capital is a weak proxy). Third, the regression errors are large and lead to a wide range of output gap estimates. Finally, in the regression specification, the coefficient estimates apply to five-year averages of growth, hence producing a step-like function of potential growth (Figure 2).

D. Production Function Approach

39. **The production function approach describes the functional relationship between output and factor inputs.** It focuses on the supply potential of the economy and calculates potential output as the level of output given 'normal' rates of capacity utilization. The rate of capacity utilization is said to be normal when the labor and capital input is consistent with non-accelerating wages and inflation, and total factor productivity (TFP) is at its trend level.

40. **A standard Cobb-Douglas production function is adopted for the analysis.** The Cobb-Douglas production function is the most widely-used production function and has the advantage of simplicity and flexibility. The production function is given as:

$$Y^* = TFP^* \left(u_l^* L\right)^{\alpha} \left(u_k^* K\right)^{1-\alpha}$$

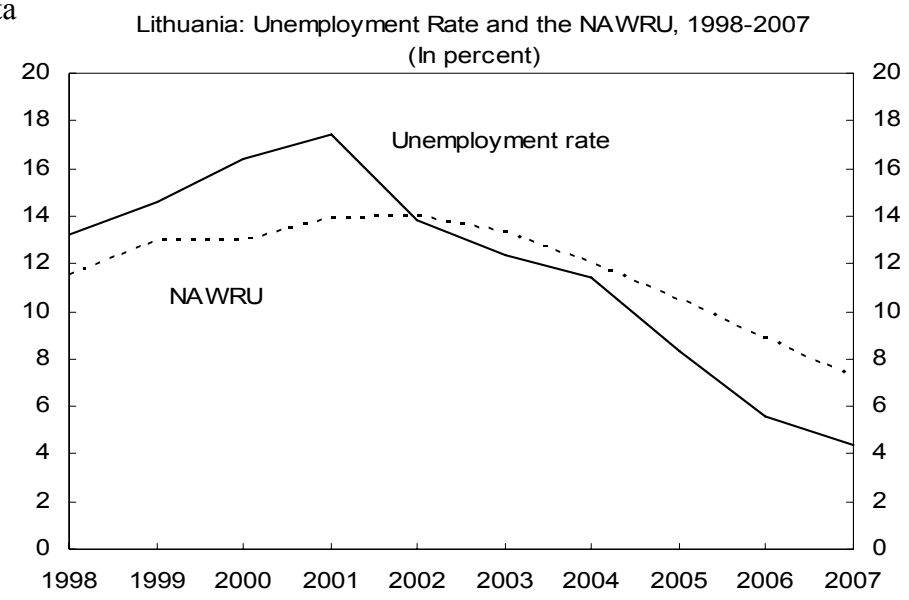
where u_l^* is the nonaccelerating wage rate of labor utilization (NAWLU), u_k^* is the nonaccelerating inflation rate of capacity utilization (NAICU), TFP^* is trend total factor productivity (TFP) growth, Y^* is real GDP, L is employment, and K is an estimate of the economy-wide capital stock.

41. **Capital stock is constructed in line with the perpetual inventory method.** Following Schadler and others (2006), we assume an 8 percent depreciation rate and an initial (1995) capital-output ratio of 2 percent, which was based on predicted values from a regression of capital-output ratios on per capita income levels and investment rates. In line with the literature (see Arratibel, et al, 2007), the share of labor in output is assumed to be 0.65.

42. **Since estimates of the NAICU are not available for Lithuania, estimates from comparable economies are used.** Estimates for the NAICU range from 75 percent to 85 percent for advanced economies. In the case of Russia, Oomes and Dynnikova (2005) estimate the NAICU at 74½ percent. However, the NAICU is generally higher for more advanced economies, and for countries with more competition, better management techniques and more flexible labor and product markets (Nahius, 2003). In the absence of

data on the NAICU in Lithuania, we assumed a constant NAICU of 74½ percent. If Lithuania's NAICU had, however, increased over time, a larger share of growth would have been attributed to capital accumulation than currently assumed, and a smaller share to TFP growth.

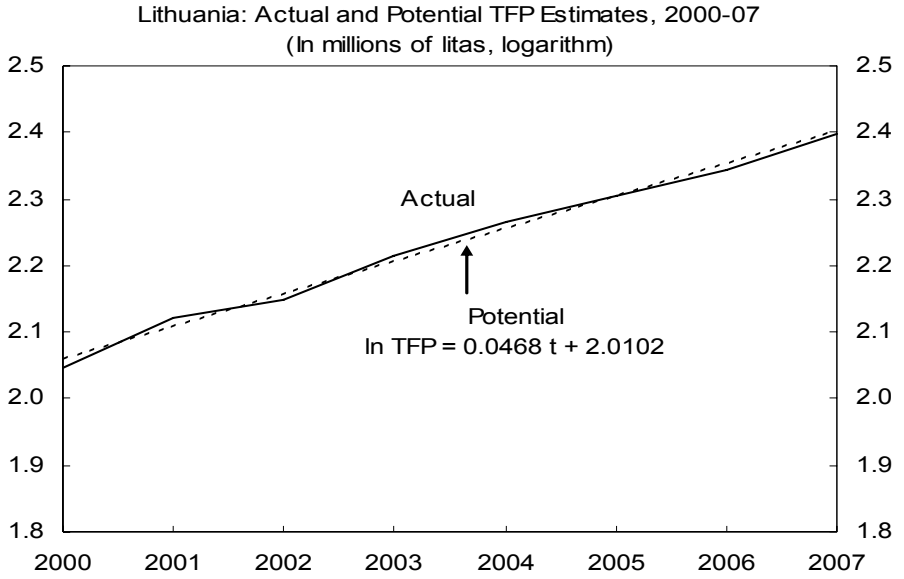
43. **The labor input is calculated by applying the European Commission's estimate of nonaccelerating wage rate of unemployment (NAWRU) to labor force data.** We use historical labor force data provided by Statistics Lithuania. Using intrapolation when necessary, our labor force projections are based on the United Nation's population projection and assume a constant rate of labor force participation. The text figure shows the rapid decline in the unemployment rate since 2002 and the slower fall in the NAWRU as estimated by the European Commission.



44. **Given capital, labor and output, TFP is a residual.** Assuming that potential TFP growth has been constant during 2000 to 2007, we fit an exponential trend for TFP:

$$\ln TFP = \alpha + \beta time$$

where α is a constant and β represents the average growth of TFP. Our estimation of TFP begins from 2000 in order to avoid the slump in GDP that occurred in 1999. The estimated trend equation suggests that TFP has, on the average, grown by about 4¾ percent between 2000 and 2007.



45. **Based on evidence from coincident indicators, we assumed a zero output gap for 2002.** In 2002, inflation in nontradables was nearly zero, real wage growth was broadly in line with real GDP growth and the nonoil trade balance was low at -3.3 percent of GDP. These estimates suggest that demand pressures were small during 2002.

46. **Our production function estimates suggest that actual growth has exceeded potential growth throughout 2000–07.** Potential growth is estimated to be about 8.0 percent in 2007, up from 7.7 percent in 2006. These estimates are similar to the estimates of potential growth produced by the European Commission.

Lithuania: Real GDP Growth and Output Gap Estimates Using Production Function Approach, 2000-07

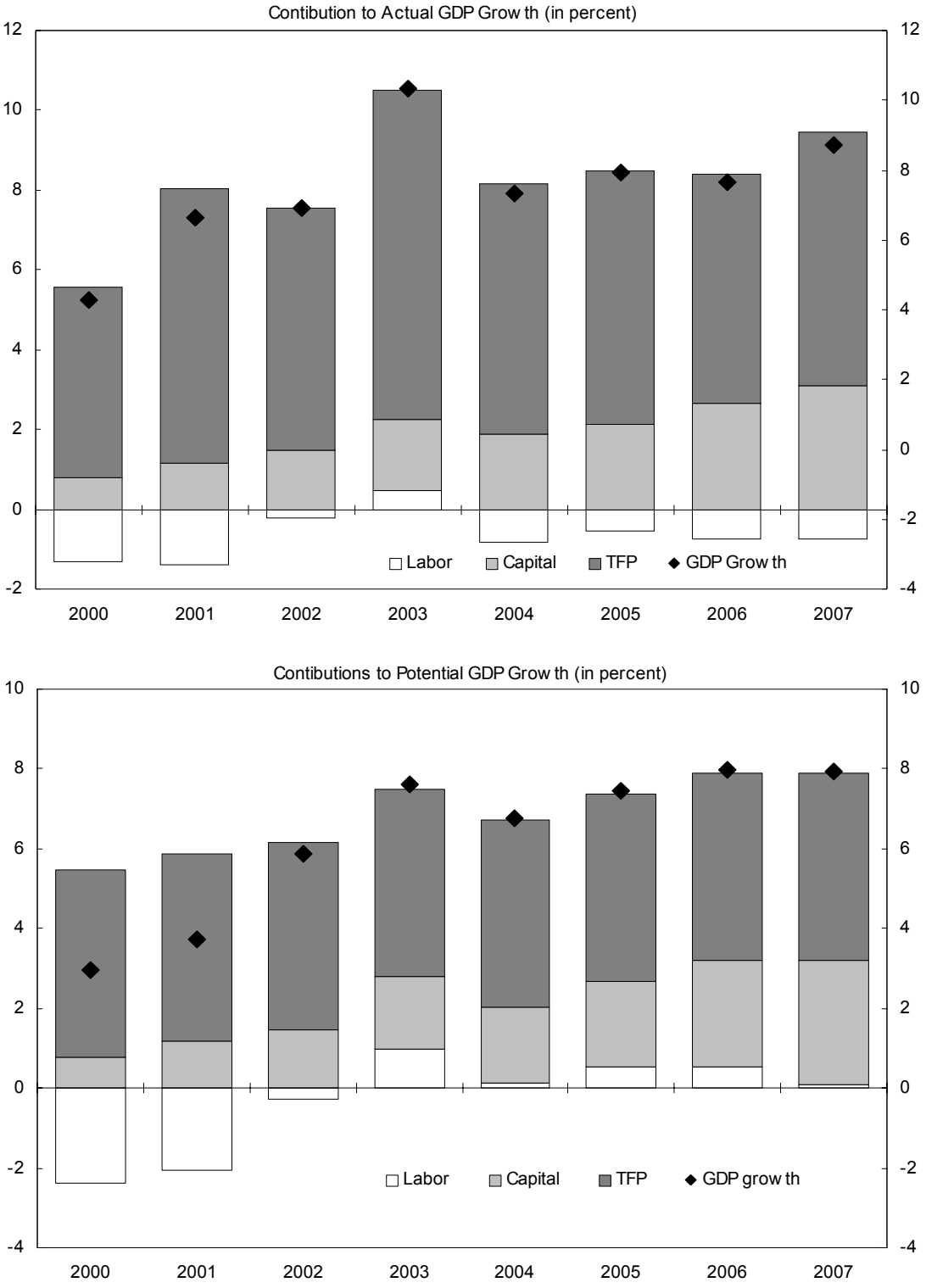
	2000	2001	2002	2003	2004	2005	2006	2007
				Percent change				
Actual GDP	4.3	6.6	6.9	10.3	7.3	7.9	7.7	8.7
Potential GDP	2.9	3.6	5.8	7.6	6.7	7.4	7.5	8.1
				In percent of potential GDP				
Output gap	-3.8	-1.0	0.0	2.6	3.2	3.7	3.8	4.5
Memorandum item:								
EC potential GDP (Percent change)	3.5	4.6	5.7	6.6	7.0	6.9	7.0	7.0

Sources: Lithuanian authorities; and IMF staff calculations.

47. **Potential growth was mostly driven by TFP growth, but the contribution of capital to growth is rising.** TFP has the largest contribution to both actual and potential GDP growth rates, on average accounting for more than two-thirds of potential growth (Figure 3). The increase in the potential growth rate has also been increasingly due to the contribution of capital. The growth of capital has been directly related to the rapid investment growth following accession to the European Union (EU).

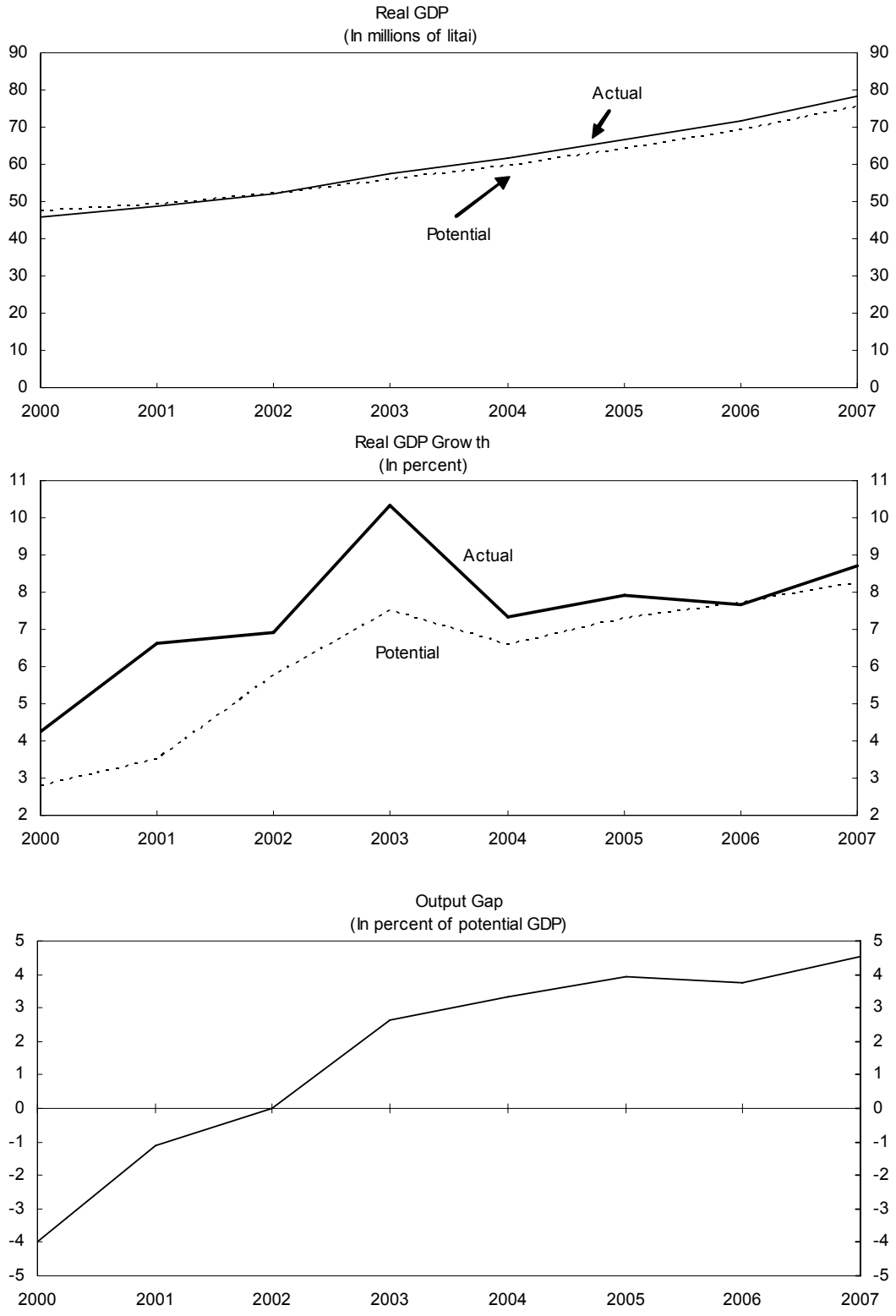
48. **The production function approach suggests an output gap around 4½ percent of potential output in 2007, up from 2.6 percent in 2003** (Figure 4). Over the period 2000 and 2007, the output gap ranged from -4.0 percent to 4½ percent.

Figure 3. Lithuania: Contribution of Factor Inputs to Actual and Potential Growth, 2000-07



Source: IMF staff estimates.

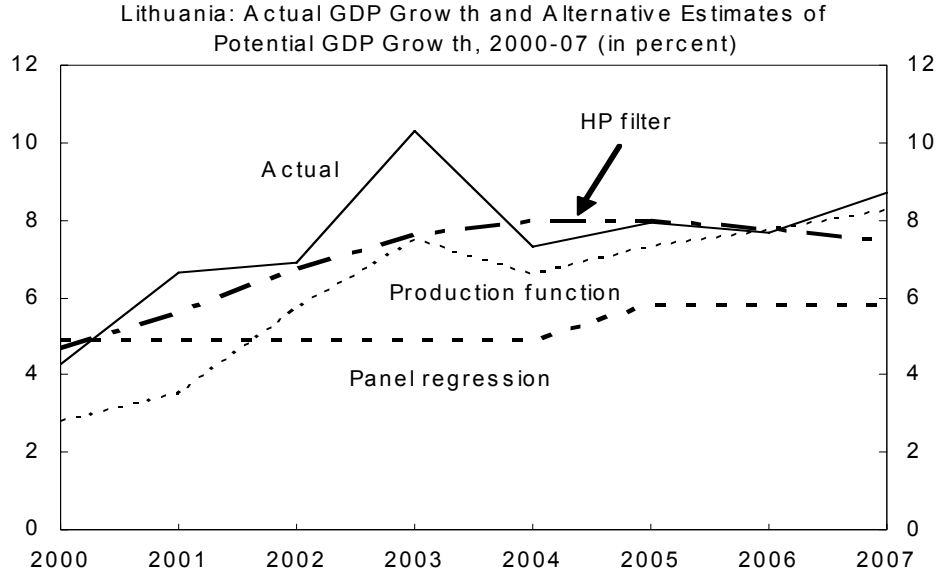
Figure 4. Lithuania: Potential GDP Growth
Estimated using Production Function Approach, 2000-07



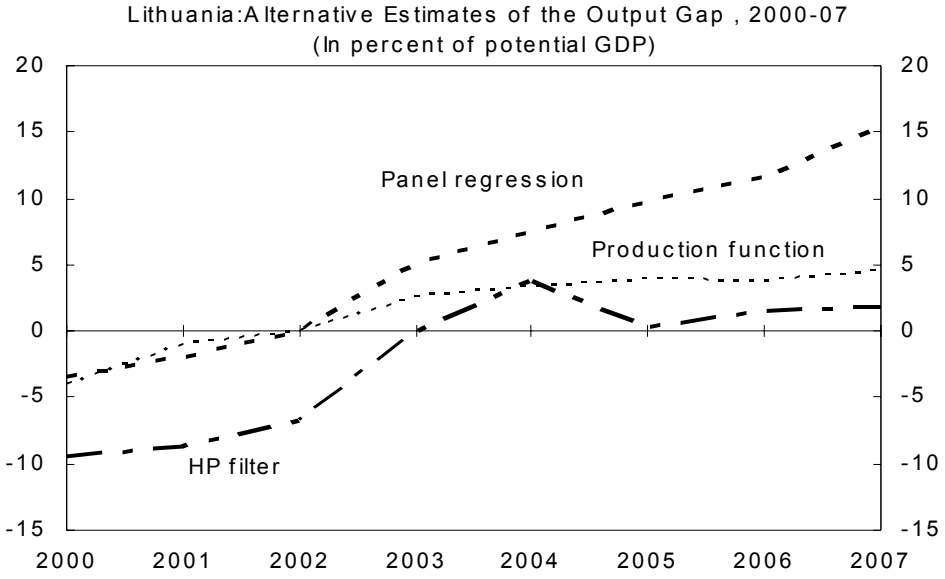
Source: IMF staff estimates.

E. Comparison of Results

49. **The three estimates of potential growth differ in the degree to which they track actual growth.** Being essentially a smoothed average of actual growth, the HP filter-based estimate tracks actual growth most closely and has the smallest estimates of the output gap. At the other extreme is the regression approach that holds potential growth constant over five years. Swings in actual growth therefore open wide output gaps. In-between is the estimate of potential growth from the production function approach. It shows flexibility over time and tracks the turning points in actual growth.



50. **The estimates are highly correlated with direct measures of demand pressures.** Between 2000 and 2007, nontradables price inflation, real wage growth and the non-oil trade deficit all point to a tightening of supply constraints (Figures 5–7). Correlation coefficients between these coincident indicators and estimates of the output gap vary somewhat, but the estimated confidence intervals show that these differences are not statistically significant. While the correlation coefficients from the panel regression estimates are slightly higher than estimates from the other approaches, the panel regression estimate of the output gap (15¼ percent) for 2007 is implausibly high. The panel regression does, however, provide an idea of the balance of risks, namely, that the output gap may actually be higher than our preferred estimate of 4½ percent suggested by the production function approach.



Correlation Coefficients between Estimates of the Output Gap and Coincident Indicators, 2000–07

	HP Filter	Panel	PF
Inflation (nontradables)	0.50	0.78	0.74
Confidence interval 1/	0.10 to 0.83	0.55 to 0.96	0.34 to 0.92
Real wage growth	0.73	0.86	0.84
Confidence interval 1/	0.36 to 0.91	0.64 to 0.96	0.59 to 0.95
Non-oil trade deficit	0.72	0.85	0.74
Confidence interval 1/	0.36 to 0.91	0.64 to 0.96	0.36 to 0.91

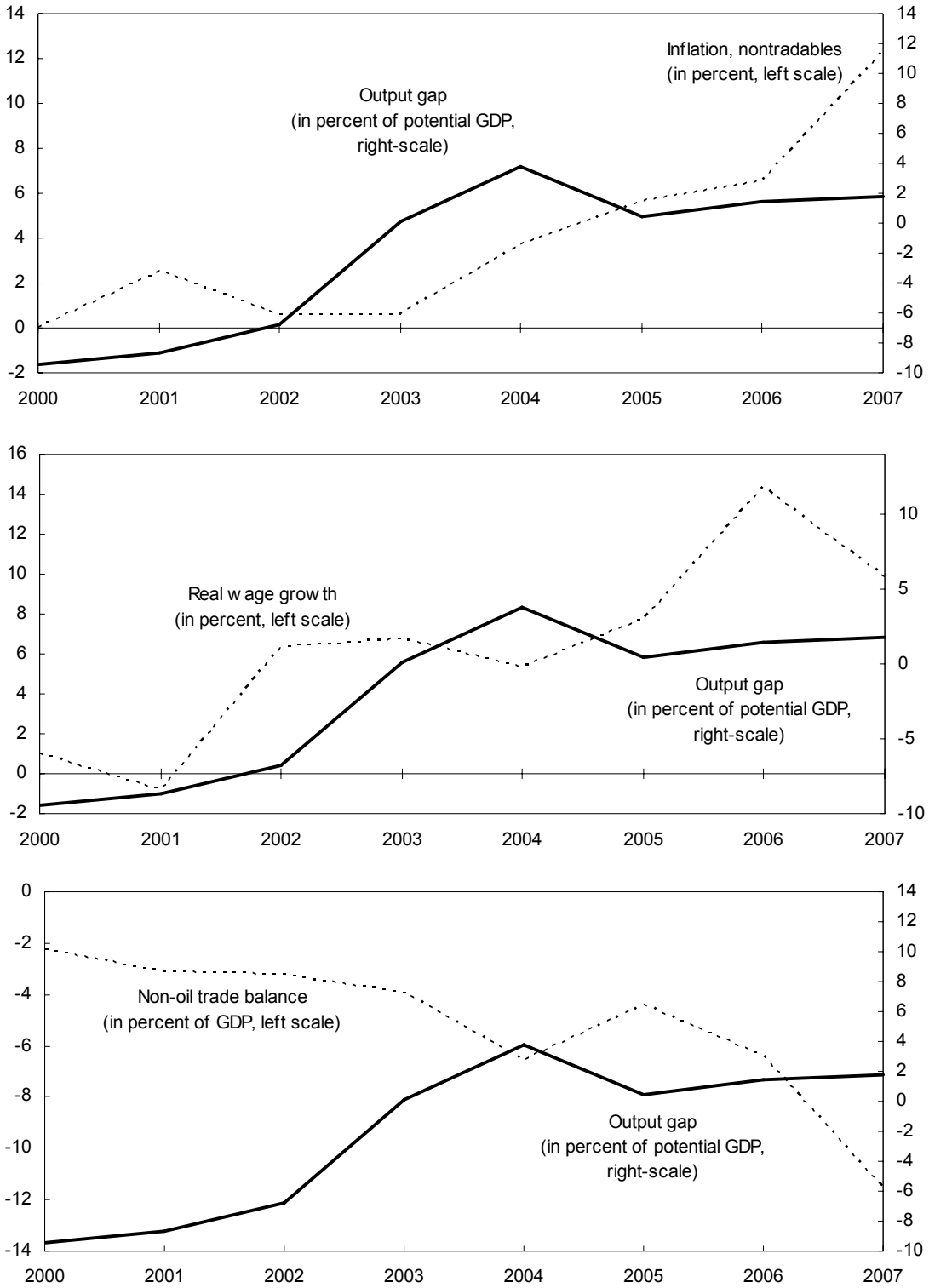
Source: IMF staff calculations.
1/ 80 percent confidence intervals.

Lithuania: Coincident Indicators with Alternative Estimates of the Output Gap, 2000-07

	2000	2001	2002	2003	2004	2005	2006	2007
	In percent, unless otherwise indicated							
Inflation (nontradables, end-period)	...	2.5	0.6	0.6	3.7	5.6	6.5	12.3
Real wage growth (end-period)	1.0	-0.8	6.3	6.8	5.4	7.7	14.3	9.8
Non-oil trade balance 1/	-2.3	-3.1	-3.3	-3.9	-6.5	-4.4	-6.4	-11.5
Output gap	In percent of potential output							
Production function	-4.0	-1.1	0.0	2.6	3.3	3.9	3.8	4.5
Panel regression	-3.5	-1.9	0.0	5.2	7.6	9.7	11.6	15.3
HP filter	-9.4	-8.7	-6.8	0.1	3.8	0.4	1.5	1.8

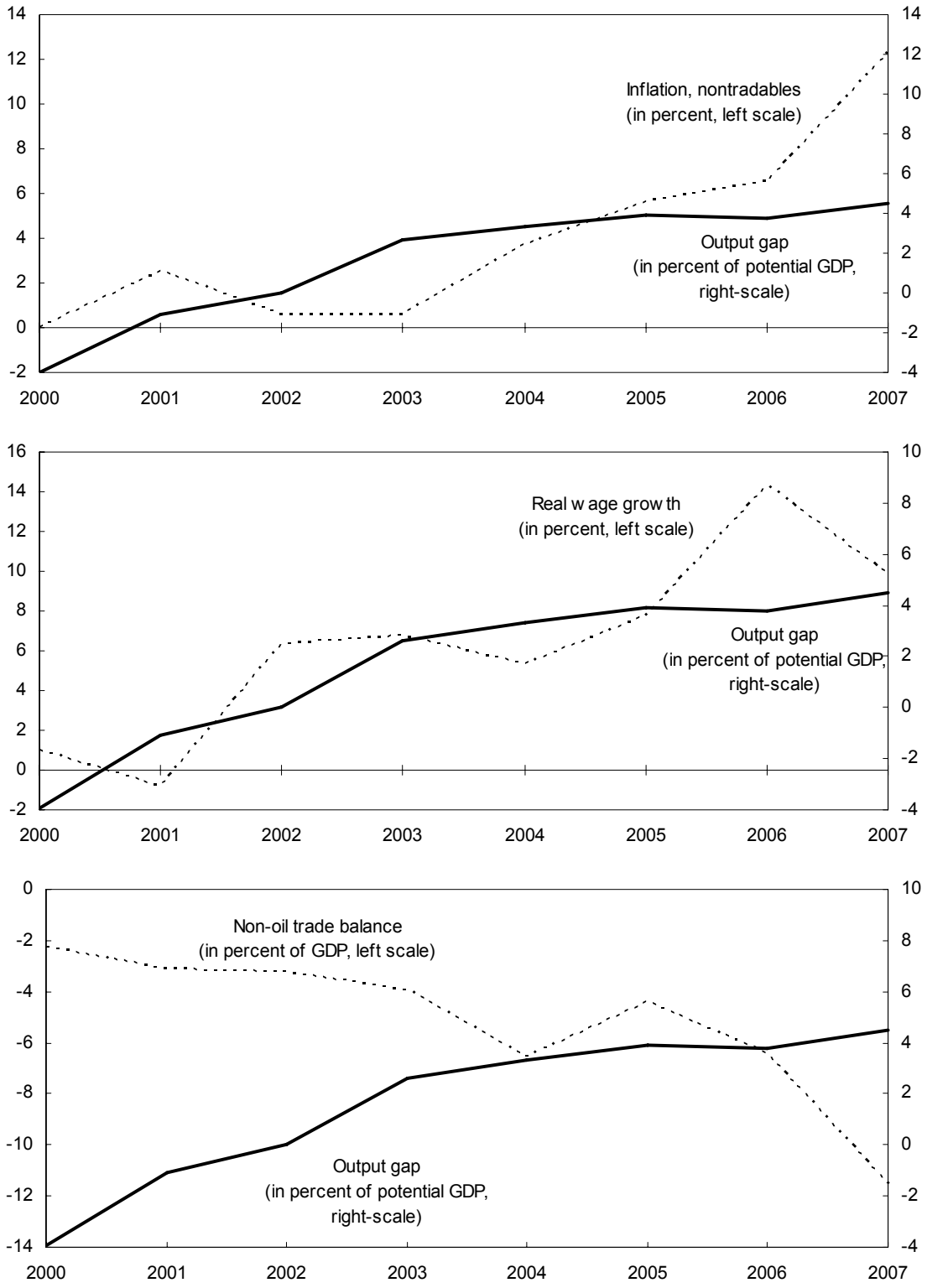
Sources: Lithuanian authorities; and IMF staff calculations.
1/ In percent of GDP.

Figure 5. Lithuania: Comparison of Output Gap Estimates from the HP Filtering Approach with Selected Coincident Indicators, 2000-07



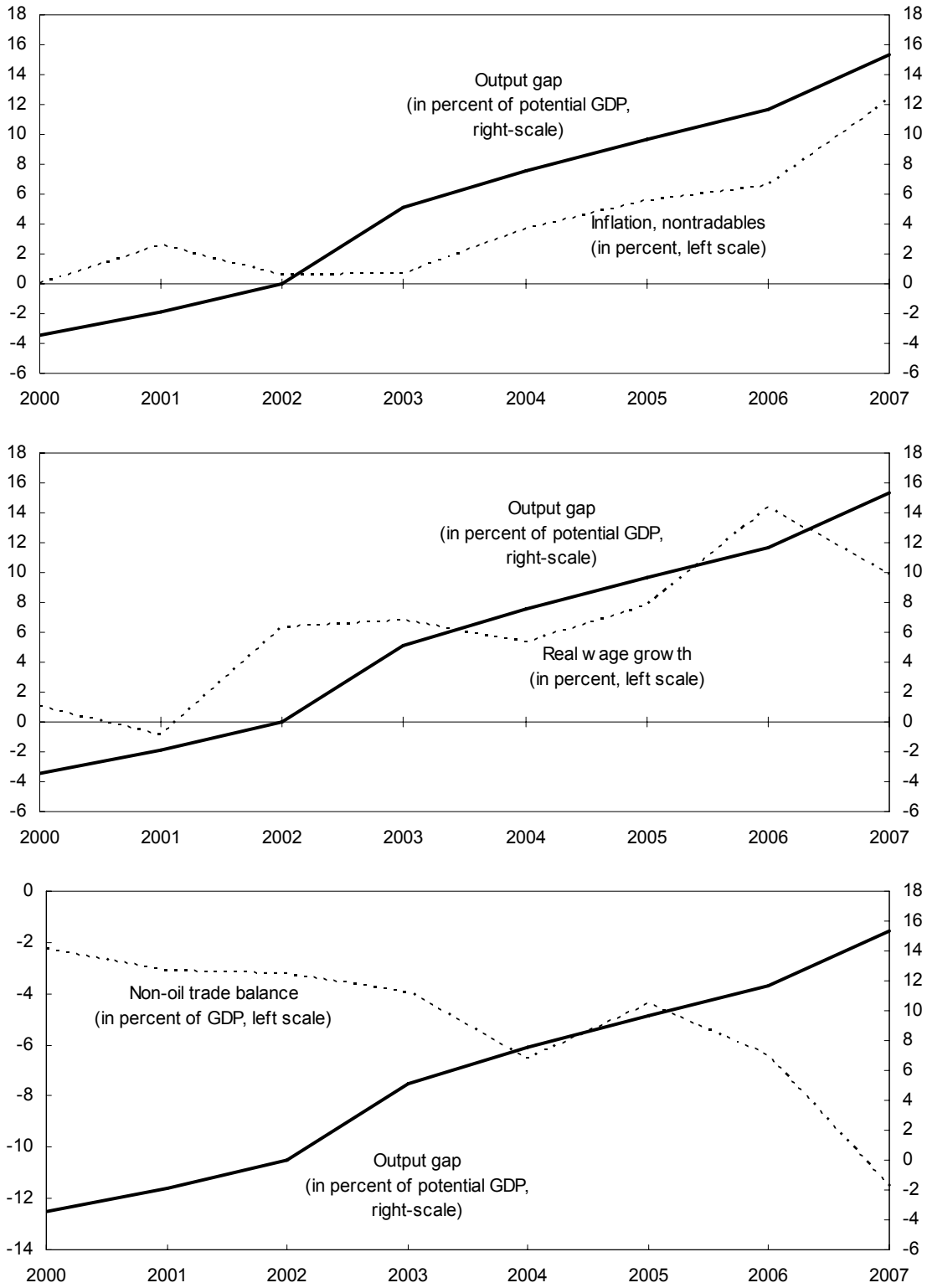
Source: IMF staff calculations.

Figure 6. Lithuania: Comparison of Output Gap Estimates from the Production Function Approach with Selected Coincident Indicators, 2000-07



Source: IMF staff calculations.

Figure 7. Lithuania: Comparison of Output Gap Estimates from the Panel Regression Approach with Selected Coincident Indicators, 2000-07



Source: IMF staff calculations.

F. Conclusions

51. **This paper estimated the output gap in Lithuania using three different methodologies: an HP filter, a panel regression and a production function.** All three approaches suggest an increase in demand pressures over the past five years, consistent with developments of coincident indicators over the same period. Each method has strengths and weaknesses. Although the HP filter is a simple and widely-used methodology, it is subject to end-sample bias, and may obtain spurious cyclicality for integrated series. The panel regression provides a rich explanation of potential growth but systematically underestimates potential growth in Lithuania with large regression errors. While the production function approach describes the functional relationship between output and factor inputs, it rests on several ad-hoc assumptions. As the extremely high output gap in 2007 suggested by the panel approach appears unrealistic, and the estimate produced by the HP filter is least correlated with coincident indicators, staff's preferred approach is the production function approach.

REFERENCES

Arratibel, O, F. Heinz, R. Martin, M. Przybyla, L. Rawdanowicz R. Serafini and T. Zumer (2007) "Determinants of Growth in the Central and Eastern European Member States—A Production Function Approach," *European Central Bank Occasional Paper 61/April 2007.*

Harvey, A.C. and A. Jaeger, 1993, "Detrending, Stylized Facts and the Business Cycle," *Journal of Applied Econometrics*, 8, 231–47

Hodrick, R. J., and E. C. Prescott, 1997, "Postwar U.S. Business Cycles: An Empirical Investigation," *Journal of Money, Credit, and Banking*, Vol. 29 (February), pp. 1–16.

Nahuis, N. J., 2003, "An Alternative Demand Indicator: The 'Non-Accelerating Inflation Rate of Capacity Utilization'," *Applied Economics*, Vol. 35, No. 11, pp. 1339–44.

Oomes, N. and O. Dynnikova, 2005, "The Utilization-Adjusted Output Gap: Is the Russian Economy Overheating?," Selected Issues Paper, IMF Article IV Consultation.

Schadler, S., A. Mody, A. Abiad, and D. Leigh, 2006, "Growth in the Central and Eastern European Countries of the European Union," *IMF Occasional Paper* 252

World Bank, 1993, "*The East Asian Miracle: Economic Growth and Public Policy*," Oxford University Press