Evaluating the UN Global Policy Model

Jo Michell[1]

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1 Introduction

This paper summarises and synthesises the reports presented by invited experts at the technical workshop on the United Nations Global Policy Model (GPM) at the UNCTAD offices in Geneva on 15 December 2015. Reports were submitted by Michael Landesman, Marc Lavoie, Özlem Onaran and Servaas Storm. Each expert was asked to produce an assessment of a specific aspect of the GPM. This paper will draw out the main conclusions, observations and criticisms made in these reports. Conclusions will be drawn on the validity and applicability of the GPM for continued policy simulation work at UNCTAD. In the remainder of the paper, references to the above authors refer to the GPM reports, unless otherwise specified.

2 Model overview

The GPM is a policy-oriented modelling tool designed for analysis of historical data trends and generation of simulations of possible future scenarios (Cripps & Izurieta, 2014). The GPM comprises two main components: a bespoke global databank, the World Data (WD) databank, and a macroeconometric simulation model.

The databank was developed by a team at Alphametrics led by Francis Cripps, with additional input and support from staff at organisations such as UN/DESA, UNCTAD and the ILO. It has undergone a series of methodological revisions from its inception at the Cambridge Economic Policy Group in the late 1970s.

The model was developed by UN/DESA in 2007, under the supervision of Jomo K.S. and Rob Vos, and was transferred to UNCTAD, in collaboration with the ILO from 2013.[2]

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[1] Jo Michell, University of the West of England, Coldharbour Lane, Bristol BS16 1QY, UK, email: jo.michell@uwe.ac.uk

[2] The underlying principles of the GPM are derived from the Cambridge-Alphametrics Model (CAM), which was developed at the University of Cambridge with Cripps as lead developer. At present, both the GPM and its academic counterpart (CAM) are supported and developed by a growing network of UN officials and academics respectively.

The WD databank contains a large number of historical data series for almost all countries of the world from 1970 to the present day. These include trade data, macroeconomic aggregates, financial stocks and flows, demographic data, price indices and others. These data are sourced from international organisations such as the World Bank, the IMF and the UN Population Division. Many data series are subject to checks, revisions and, in some cases where there are missing or erroneous data, estimation before inclusion in the databank.[3] In particular, data need to be adjusted to ensure the internal consistency of the databank as a whole.[4] The result of this adjustment process is an internally stock-flow consistent databank covering 45 years of historical data.

It should be stressed that the value of the WD goes far beyond its use with the GPM model alone. It is the only time series database of its kind, containing a broad array of widely-used macroeconomics, finance, trade, employment and environmental variables, constructed in strict adherence to accounting principles. Onaran notes that the collation and maintenance of such a databank "is invaluable for an international research community."

This databank is aggregated into regional blocs for the purposes of scenario modelling. The aggregation procedure is flexible, allowing countries to be grouped in different ways. It is possible to produce simulations with the global economy divided into 25 or more blocs, each of which may be a single country or group of countries. This flexible aggregation procedure is important because it permits users to set up country and bloc structures appropriately for their intended scenarios.

The macro simulation model is made up of a combination of behavioural equations and accounting identities.[5] The latter impose stock-flow consistency on the system. Balance sheets are maintained for each bloc and financial and real flows are tracked

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[3] The current user interface of the WD allows users a range of options when selecting data series. There is a trade-off between reliability of data and coverage and consistency. When selecting data, users have options varying from selecting only data taken directly from official sources (which have many empty series and missing observations) to selecting 'complete' data (with some gaps filled by interpolation or estimation) and 'consistent' data which has been adjusted to eliminated accounting holes, and where accounting residuals have been distributed according to standard methods.

[4] For example, trade statistics are not consistent when aggregated to the global level: it appears that the planet as a whole is running a trade deficit

[5] See Cripps & Izurieta (2014) for a recent overview of the model structure and behavioural specification.

during simulation, along with revaluations due to price changes, exchange rate movements and so on. The behavioural equations are econometrically estimated using a fixed-effects panel.[6] In addition to identifying 'global' behavioural parameters, the panel estimation procedure incorporates a strategy to capture key structural characteristics of individual blocs. This is done by including variables which measure the size and development of the bloc (e.g. PPP GDP and per-capita GDP), financial positions (e.g. financial deficits and size of gross balance sheets) and other structural features during estimation. This enables the econometric estimation to capture structural differences between economies while avoiding the artificial use of dummy variables. According to Onaran, a panel estimation strategy of this type is appropriate for a global model in which issues of data completeness and reliability are likely to be significant, particularly for developing countries. Storm notes that the method compares favourably with the usual approach of neoclassical computable general equilibrium (CGE) modellers in which parameters are calibrated.

Model simulation produces detailed macroeconomic projections which are stock-flow consistent at the both bloc and global levels. Simulations can be used to examine the likely future paths of the global economy under a range of assumptions about about trends, shocks and policies. The model authors emphasise, however, that the model is not intended to make predictions about the future per se, but is instead a tool which can be used for exploring possible policy scenarios within an internally-consistent system based on plausible assumptions and empirically-grounded behavioural relationships.

3 Modelling approach

All of the experts' reports offered comments on the structural econometric modelling (SEM) approach of the GPM. The underlying methodology differs considerably from that of both the currently dominant neoclassical dynamic stochastic general equilibrium (DSGE) approach and from the older class of neoclassical CGE models. Lavoie places the division between neoclassical macroeconomics and other approaches in historical context. He locates the modelling methodology of the GPM within the structuralist approach associated with Lance Taylor (1990). The intellectual roots of this approach can be traced back to the work of John Maynard Keynes, Nicholas Kaldor and Michal Kalecki.

[6] Estimated parameters require adjustment in some cases, for example where strong feedback effects occur in co-determined variables such as GDP growth and investment growth.

3.1 Hysteresis, path dependency and demand-supply interactions

The canonical DSGE model (e.g. Woodford, 2003) is constructed on the basis of neoclassical representative-agent microfoundations. In plainer language this means that it is assumed that the economy can be represented by single agent who is faced with a straightforward optimisation problem: to decide on how much to consume and work in the present period versus the future. Since the agent is assumed to transact in complete and perfect financial markets and (on average) will correctly predict the future (the so-called "rational expectations hypothesis"), she will only find herself in a sub-optimal state as a result of shocks to the system. In the aftermath of such shocks – which result from shifts in technology, preferences, expectations, population size and other exogenous factors – New Keynesian DSGE models posit slow adjustment back to equilibrium. This is the result of imperfections such as wage or price stickiness, or "frictions" resulting from imperfect information in credit markets.

As a result of these assumptions, neoclassical models posit that the economy will mechanically return to a "natural" steady-state growth path in the aftermath of shocks, usually through a process of non-instantaneous price and wage adjustment. Storm notes the implication is that macroeconomic management is in essence reduced to a task of fixing the interest rate in order to hit an inflation target, while the use of fiscal policy is subordinated: "monetary policy strictly dominates fiscal policy and hence the effectiveness of fiscal policy is circumscribed by the monetary-policy imperative". International policy coordination is likewise downplayed: "the economics mainstream treats global policy coordination as a second-order issue and of limited and only temporary importance".

Lavoie notes that neoclassical DSGE models have been the target of sustained criticism since the financial crisis. Olivier Blanchard, former chief economist at the IMF stated that that the crisis "raises a potentially existential crisis for macroeconomics" (IMF, 2015). Other high-profile economists such as Robert Solow, Joseph Stiglitz and Willem Buiter have likewise criticised DSGE models for their lack of realism and applicability to real-world issues.[7]

[7] Oxford University professor Simon Wren-Lewis (2016) argues that DSGE models are often not suitable for use in policy-making because policy-makers "want stories that are relevant to the real world! A DSGE model is more likely to be subject to specification errors because it ignores real-world complications" (p. 31). The difficulties of capturing realistic behaviour in such models leads economists to a position where "if we do not understand something, it is best when formulating policy to assume that something does not exist!" (p. 28). Despite this, "students are also taught that [non-DSGE] methods of analysing the economy are fatally flawed, and that simulating DSGE models is the only proper way of doing policy analysis. This is simply wrong."

A key issue is hysteresis—the possibility that economies hit by a demand-side shock may not fully recover but may instead shift to a new growth path. As noted above, this possibility is excluded by assumption in standard neoclassical models because price adjustments will ensure an eventual return to the "natural" growth path. But the experience of the financial crisis and the weakness of the subsequent recovery have strongly undermined the belief in such a mechanism: Larry Summers has argued that "this financial crisis has confirmed the doctrine of hysteresis more strongly than anyone might have supposed" (quoted in Ball, 2014, p. 149).

On the basis of a study of the impact of the 2008 financial crisis on 23 countries, Ball (2014) notes that reduced capital accumulation, lower labour-force participation and slower productivity growth have generated contractions in the rate of potential output "almost one-for-one" with demand shortfalls (p. 149). The 2008 crisis is not a special case: on the basis of a study of over 120 recessions, Blanchard et al. (2015), conclude that in over two-thirds of cases, potential output fell as a result of the recession. Further, they find that in a third of cases, potential growth was lower after the recession—a phenomenon referred to by Ball as "super-hysteresis". In these cases, not only do economies fail to return to their previous growth *path*, they also fail to recover their previous growth *rate*.

Lavoie notes that, while largely excluded by assumption by neoclassical modellers, "super-hysteresis" has long been a feature of structuralist Keynesian models such as the GPM, which incorporate the Kaldorian hypothesis that productivity is not purely a supply-side phenomenon but also responds to aggregate demand. The growth paths of individual economies, and of the world economy, are not pre-determined or exogenously given in the GPM but evolve through time in response to shifts in demand, trade patterns and so on. As a result, the model generates projections in which output and productivity are path-dependent and determined by the interaction of economic variables, rather than being imposed by unexplained "non-economic" factors such as population growth and technological change.

Landesman notes that the GPM incorporates mechanisms which link productivity growth to demand—the Smith-Verdoorn-Young-Kaldor effects—as well as potential feedbacks from rising productivity to demand. Demand, and therefore employment and productivity, react to such factors as income distribution (see Section 4.2), the

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Wren-Lewis concludes that policy-makers should return to the use of Keynesian structural econometric models: "We do not need another methodological revolution as a response to this crisis, but instead a resurrection of the older methods that were inspired by *The General Theory*" (p. 34).

degree to which production is domestically versus externally oriented, credit availability, as well as tools such as monetary and fiscal policy. It is therefore inaccurate to characterise the GPM (as some have done) as a model in which "production structures and productivity growth do not play an important role for determining medium-run developments in the model".

Given this specification, increases in government spending have a positive and (via productivity) potentially persistent effect on aggregate demand and output. Fiscal multipliers are not imposed, but can be imputed from model projections. Fiscal multipliers predicted by the GPM on the basis of recent simulations range between 1.30 and 1.85 (see TDR 2013, Table 1.4, p. 13, for a country-specific list). These are higher than the values which had been widely assumed by macroeconomic modellers and official institutions until recently – assumptions which underpinned the ill-fated drive for fiscal consolidation pushed by the IMF in Europe. As highlighted by both Storm and Onaran, recent econometric analysis by Blanchard & Leigh (2013) and Fatás & Summers (2015) provides compelling evidence that these estimates were significantly below true multiplier values. Blanchard & Leigh report post-crisis multipliers of around 1.5, while Fatás & Summers report a value of 1.6-1.7 for the long-run multiplier in the Euro area.[8] These estimates are slightly higher than multiplier values predicted by the GPM: 1.38 for Germany, 1.48 for France, 1.48 for Italy and 1.32 for the UK. The GPM posits larger multipliers for emerging and developing economies: for example, a multiplier of 1.76 is predicted for China. Storm notes that these values indicate that government investment programmes have the potential to be self-financing in the long-run and concludes that GPM policy projections which produce these multipliers are "perfectly plausible" (p. 36).

3.2 Accounting detail and consistency

The second key feature of the GPM model noted in all of the expert reviews is the use of a "stock-flow consistent" modelling approach. As Lavoie has argued, the

[8] On the basis of a large meta-analysis, Gechert (2013) notes that the size of predicted multipliers is highly dependent on the modelling methodology adopted. Real Business Cycle models predict almost no effect of fiscal policy, while New Keynesian models predict more powerful but transitory effects (i.e. no hysteresis). Structural econometric models predict stronger and more persistent multipliers. This confirmed by referring to the older literature: Adams & Klein (1991) surveyed the structural econometric models of the United States most widely used in academia and official institutions at the time and found average multiplier values of around 1.5.

terminology is potentially misleading: neoclassical DSGE models are stock-flow consistent in the sense of being internally consistent but, since these models usually either assume that financial structure is irrelevant (capital markets are "perfect") or introduce generalised abstract financial "frictions" (usually resulting from uneven access to information), such models offer little insight into the dynamics of monetary and financial variables. What matters, therefore, is not just the consistency of the accounting using in model construction, but also the level of detailed disaggregation and the underlying assumptions about the influence of monetary and financial variables on the economic system.

Since the crisis, a small number of DSGE models have appeared which do include explicit modelling of the financial system (for example, Kumhof et al., 2012). But since such models retain the macroeconomic assumptions detailed in the previous section—most importantly the assumption that the economy will always return to its long-run steady state growth path—the possibility of sustained financial imbalances is excluded. As such, attempts to incorporate the financial system into DSGE models in any meaningful way will "generate a great deal of strain and inconsistency" and require "*ad hoc* adjustments and additions" (Lavoie, p. 8). Lavoie observes that the experience of trying to make monetary and financial variables play a meaningful role in DSGE models largely replicates that of an earlier generation of modellers who attempted, mostly unsuccessfully, to incorporate financial and monetary stocks into CGE models.

These efforts by DSGE modellers reflect a deepening awareness that financial and monetary stocks, far from being inert and transitory, play an important role in today's interconnected world. The accumulation of financial imbalances, both within national economies—such as those which fuelled the pre-crisis housing boom in the US—and internationally—the so-called "global imbalances"—has been identified as one of the deeper structural causes of the 2008 crisis. It is unlikely to be coincidence that, of those economists who did foresee problems in advance of the 2008 bust, a significant number were working with a flow-of-funds or stock-flow-consistent macroeconomic framework. One notable example is Wynne Godley who led a team of macroeconomic modellers at the Levy Economics Institute. Godley, whose work with Cripps in the 1970s laid the foundations for the methodology of the GPM, repeatedly warned of the problems of financial imbalances in the run up to the 2008 crisis and is widely credited as being one of the few economists who saw the crisis coming.

The importance of tracking monetary and financial flows is highlighted by Blanchard. He concedes that macroeconomists had incorrectly assumed they could ignore the specifics of the "plumbing" of economic systems: "we have learned that the plumbing, especially the financial plumbing matters" (IMF, 2015). The flow-of-funds accounting techniques upon which the GPM is constructed ensure not only that the plumbing is

part of the model, but that the plumbing doesn't leak. Lavoie highlights the importance of the detailed financial accounting framework in the GPM. Balance sheets are maintained for the private and public domestic sectors (including separate balance sheets for the financial system) and for the international lending and borrowing positions of countries and economic blocs. Both gross and net positions are included and these positions adjust alongside real sector flows such as production, income, expenditure, and trade in such a way that there are no "black holes": all flows between sectors are matched by changes in stocks. Stocks also adjust to account for revaluation effects due to price and exchange rate shifts, and to write-offs due to bad debts. Imports and exports are matched globally as are international capital flows.

The production of a global stock-flow consistent dataset and econometrically estimated model of this type is described by Lavoie as a "remarkable achievement":

> There are few models out there that cover the whole world; there are few that are estimated econometrically rather than being dependent upon calibration; and while all computable general equilibrium (CGE) models also claim that they have water-tight accounting, very few of them do so by taking into account the evolution of financial flows and a fortiori financial stocks.

3.3 International trade and development

The modelling of trade in the GPM is relatively detailed for an econometrically estimated global model which incorporates both real and financial variables. Four categories of trade are distinguished: manufactures, services, primary products and energy. Trade in manufactures is modelled on a bilateral basis. Services and primary products are modelled on the basis of a "pool system" in which both prices and quantities adjust in response to shifts in supply and demand. Energy production, usage and trade are modelled on a physical basis such that the world oil price adjusts to clear the market. Production of non-carbon energy is included as a separate category and this is assumed to be driven mainly by domestic demand as well as the "carbon energy price" which may include adjustments for carbon taxation (Cripps & Izurieta, 2014)

Demand for manufactured imports at the bloc level is determined by the overall structure of domestic spending, on weighted average costs, and on the real exchange rate. The structure of global demand for manufactures is determined mainly on the basis of supplier unit costs. Demand for services is modelled on the basis that services are complementary to goods from the other three categories, although a negative sign in the estimated parameter for complementarity could instead capture patterns of specialisation. The modelling of trade in primary products is done on a pool basis,

giving greater weight to the demand side and allowing for some price stickiness. This enables the model to explicitly incorporate terms-of-trade effects of primary product prices relative to a country's general domestic price level. It also allows the model to capture the important effects that shifts in commodities prices can have on trade and external debt positions.

The real exchange rate is a key relative cost variable in the GPM, affecting external trade and financial positions, aggregate demand and employment. In the GPM specification, the exchange rate is influenced by relative inflation rates domestically versus internationally as well as current account and external positions. This reflects the fact that, in a world of increasing cross-border financial integration, real exchange rate appreciation may be driven either by real factors such as productivity catch-up in the tradeable sector (the Balassa-Samuelson mechanism), or by capital inflows into non-tradeable sectors. Such capital flows, which are often speculative in nature, may have negative consequences as a result of pressure on the real exchange rate and domestic asset prices.

Landesman comments that the specification produces a fairly standard "real sector" approach to trade modelling, providing a strong basis on which to perform simulation exercises. The extent to which further detail and disaggregation of trade is possible—into different categories of services, for example—is limited by data availability and, where data is available, by the scale of the task of incorporating it. Where possible, structural features of individual economies are picked up by "fixed effects" when estimating behavioural equations on historical panel data. More detailed structural features can be captured by using "add factors" to adjust behavioural specifications when constructing scenarios. In this way, the results of other studies can be incorporated into GPM scenarios. For example, extensions have been used to incorporate the effects of trade policy agreements, labour supply changes, skill composition of the workforce, infrastructure quality and FDI.

On the topic of modelling long-run growth and development, Landesman highlights three key issues: the determinants of productivity and economic growth; international integration and specialisation and patterns of catching up or falling behind; and sectoral composition and overall economic development.

The determinants and dynamics of productivity growth differ, in particular, between advanced and catching-up economies. The ability for developing nations to successfully adopt new technologies depends on factors such as educational standards, infrastructure, institutional and legal structures and the capacity for FDI to act as a carrier of technology. In advanced nations, productivity is more dependent on innovation and the development of new technologies. As such, productivity growth in

these nations is influenced by factors such as research and development spending, financing structures and the characteristics of the educational system. The international division of labour should therefore be seen as part of an on-going process in which global production chains have deepened and production processes are becoming increasingly geographically fragmented.

Shifts in sectoral composition, particularly the shift away from agriculture, are regarded as essential elements in long-run development processes. The dynamics of such processes and the resulting effects on employment and productivity across and within sectors do not follow well-defined paths. Development trajectories and shifts in sectoral composition tend to be geographically and historically specific as well as depending on available technologies and resource endowments. Patterns of international specialisation, and therefore national productive structures, continue to evolve. It is therefore impossible to posit an "ideal" sectoral composition for catching-up nations. However, policies that may assist in sustainable catch-up include "intervention to influence the sectoral allocation of FDI and specific measures to diversify export structures supported by infrastructure investment, education and training of the labour force." (Landesman, p. 5)[9]

The complexity of these patterns, as well as problems of data availability, imposes restrictions on the extent to which a global model can fully capture the specificities of development, integration, specialisation and productivity at the individual country or bloc level. The GPM includes demand induced effects on productivity (as discussed in Section 3.1) as well as a broad sectoral decomposition of employment and productivity between agriculture, manufactures and services. Behavioural specifications are limited to those variables for which data are available and econometric evidence is strong. Beyond this, the GPM should be seen as a flexible framework to examine the implications of different patterns of development or to explore policy packages by using "extension" methods to incorporate the findings of more detailed and localised studies. This can be achieved by adjusting the add-factors of econometric equations to alter the behaviour of the GPM so that projections are aligned with the empirical and analytical findings of other research. Landesman offers suggestions on how such

[9] It is notable that in recent years the IMF has shifted position considerably on the use of direct controls as a way to deal with capital inflows (Ostry et al. 2010; IMF 2012). A recent IMF working paper concludes that inflow controls "have an undeservedly bad name" and that this can be attributed to "the free market ideology" of the 1980s and 1990s (Ghosh & Qureshi 2016).

extensions could be used to capture the links between FDI and the trade in services, and on ways that the trade specification could be augmented with sectoral composition indicators.

4 Policy application

The experts who contributed to the GPM evaluation exercise were asked to comment on specific policy-oriented applications of the model. Areas of focus included global policy coordination, employment and the labour market and income inequality.

4.1 International policy coordination

The period immediately following the 2008 financial crisis was notable for the willingness of governments around the world to engage in a coordinated policy response and, in particular, with coordinated fiscal policy. This Keynesian reaction is widely credited with stabilising the global economy: "There is a broad consensus that these policies helped avert a potentially catastrophic great depression …" (Ostry & Ghosh, 2015). It was also at odds with the prevailing theoretical consensus. This consensus has two main components: firstly, monetary policy is strongly preferred to fiscal policy and, secondly, the magnitude of cross-border spillovers from monetary policy are small enough that the gains from coordination are not usually sufficient to warrant implementation given the costs involved.

Storm notes that this policy consensus has been in retreat in over the last fifteen years as empirical evidence has accumulated which undermines it. Econometric estimation of the interdependencies of GDP growth between countries increasingly finds evidence of significant spillover effects from developed to emerging economies and non-trivial effects of spillback effects from emerging economies to developed economies (IMF, 2014). Cross-border fiscal multipliers have been found to be large—of the order of 50% of domestic multipliers (Ostry & Ghosh, 2015; IMF, 2013). Given the evidence on hysteresis, it is not surprising to find a growing acceptance that the effects of fiscal policy are not confined to the short run but may have a persistent influence on output (Fatás & Summers, 2015). This evidence is reflected in shifts at the level of policy discussion where it is increasingly common to hear calls for at least some degree of

coordination.[10] But mainstream macroeconomic theory and therefore the macroeconomic models used by international organisations such as the IMF have yet to catch up with the shifting policy debate (Benes et al. 2013; Adam et al. 2012).

Storm argues that an obvious reason for the increasing magnitude of cross-border spillovers and multipliers is the deepening integration of global production and trade. In a globalised production system, the position of national economies within global value chains will determine the scale and distribution of spillovers and the resulting trade positions and external balances of those economies. Asymmetries in production and trade between Anglo-Saxon economies and exporters such as Germany and China have produced persistent global trade and current account imbalances. As the global production system becomes more deeply integrated, the justification for cross-border policy coordination is likely to increase.

Alongside the spillovers arising from deepening trade and production, the rapid growth of financial linkages between national economic systems are of arguably even greater significance in generating spillovers through global financial markets. While the net positions arising from global current account imbalances have been identified as important contributing factors to the global financial crisis, Storm argues that gross balance sheet positions are of greater significance in generating financial vulnerabilities and potential instability (Al-Saffar et al., 2013; Borio & Distayat, 2015; Bortz, 2016).

The gross external assets and liabilities of advanced economies increased from 140% of GDP in 1990 to 420% in 2007 while the size of gross external balance sheets of emerging and developing economies (EDEs) increased fivefold between 2000 and 2013 as these economies opened domestic asset markets to foreign investors (Miles-Ferretti et al., 2010; Lane & Miles-Ferretti, 2014). The external liabilities of EDEs include significant proportions of pro-cyclical portfolio investment while EDE public debt is increasingly held by fund managers rather than official institutions, increasing vulnerability to financial cycles, shifts in sentiment and shocks such as movements in exchange rates (Akyüz, 2014).

This situation has arisen, in part, as a result of the long period of loose monetary policy in advanced nations and strong risk appetite among financial investors. The potential vulnerability of EDEs is demonstrated by the sharp capital outflows these economies

[10] Even previously staunch cheerleaders for austerity have recently changed their tune: both the IMF and OECD issued statements at the start of 2016 calling for looser fiscal policy, greater public investment and cross-border policy coordination (OECD, 2016; Lipton, 2016)

experienced in May 2013 as a result of the Fed's announcement that it intended to wind down its bond-buying programme. Since the start of 2016, global financial markets have shown renewed instability as a result of diverging monetary policy stances among central banks, uncertainty about the impact of negative interest rates, weakness in the price of oil and other commodities, and an acceleration of capital outflows from EDEs, most notably China.

Given the growing real and financial interdependence of the global economic system, and the growing consensus that "…policy preparedness and international collaboration are needed" IMF (2014, p. 12), Storm asks why the economics profession continues to dismiss international policy coordination. He traces the answer to the unrealistic assumptions underpinning the workhorse New Consensus macro (NCM) model.[11] In assuming that long-run growth is a purely supply-side phenomenon, NCM models impose a long-run vertical Phillips curve. Given the assumption of an inflation-targeting central bank, the implication is that, in a closed economy, fiscal policy is ineffective because increases in output produce higher inflation and therefore tighter monetary policy. In an open-economy setting, fiscal policy may be effective in one country but, as with competitive exchange rate devaluations, only at the expense of the rest of the world—fiscal policy is regarded as a zero sum game. In the case that all countries simultaneously implement expansionary policies, the overall effect is identical to the closed-economy case—activist policy raises inflation in all countries but has no effect on output. In imposing a long-run vertical Phillips curve, the models thus reduce international fiscal coordination to a zero-sum Nash equilibrium in a strategic cross-border game.

Storm identifies other key assumptions underpinning the NCM which impose serious restrictions on the applicability of the model for international policy modelling considerations. In general, the models assume that capital markets—including international capital markets—operate efficiently; international policy transmission mechanisms operate only through flow variables so that stocks (i.e balance sheets) can be disregarded; and that fundamental uncertainty can be replaced with expectations which are "rational", i.e. correct other than errors due to random noise.[12]

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[11] The 'NCM model' is essentially synonymous with the DSGE models discussed in the previous sections.

[12] It is, of course true, that these assumptions can be selectively and partially dropped in extensions of NCM models which include "frictions" of various sorts which can temporarily prevent the system reaching its long-run market-clearing equilibrium.

Once these assumptions are modified—again causing "a great deal of strain and inconsistency"—the conclusions of DSGE models are partially overturned. For example, Benes et al. (2013) note that the "literature never studies environments that resemble severe economic crises" (p. 5) and, as such,

> …the profession's intuition on the subject of international coordination is still shaped by an older, pre-crisis literature that dealt exclusively with coordinating conventional monetary policies, in other words interest rate policies, during normal economic times. (Benes et al., 2013, p. 4)

On the basis of a modified nonlinear model these authors find strong justification for the use of coordinated fiscal and macroprudential policies during periods of crisis. But given the underlying structure of the model, the substantive results in "normal times" are unchanged: "We will not revisit the question of international monetary policy coordination during normal times, where we expect our model to yield the same results as the above-mentioned literature" (p. 5).

Thus, despite mounting empirical evidence in favour of cross-border policy coordination, the closest the mainstream modelling profession will come to acknowledging a role for international policy coordination is to concede that, in a crisis situation with policy interest rates at zero, coordinated fiscal has a role to play. In "normal times", however, even coordination of monetary policy remains off the table.

Storm concludes that "there is a clear need for a reassessment of the NCM conclusion that international policy coordination is a mere second-order problem" (p. 28). In particular there is a need for models which do not assume away hysteresis and therefore a role for (long-run) demand management, including fiscal policy; that do not disregard the balance-sheet dimension of international finance or assume perfect capital markets; and do not start from the assumption that policy should be restricted to inflation targeting by "omnipotent central banks".

In Storm's view, the GPM represents a significant improvement over the NCM models. Since the GPM does not assume an exogenously determined "natural" growth rate and associated "natural rate" of unemployment, hysteresis effects are possible and fiscal policy may therefore have effects in both the long and the short run. The task of modelling the effects of large cross-border capital flows and possible policy responses requires a global model which incorporates detailed accounting of international financial flows and balance sheet positions. Both net and gross external balance sheet positions are tracked when generating simulations, with the latter influenced by the

desired wealth holdings of the private sector in each bloc.[13] GPM simulations exploring the spillover effects from successive rounds of quantitative easing have been discussed in technical meetings of the G20 on a number of occasions.[14]

In recent updates to the model, more detailed feedback mechanisms have been introduced so that financial balance sheets affect the paths of exchange rates and real variables. Exchange rates are determined neither as an equilibrium response to net trade flows, nor as a result of capital flows equalising rates of return across countries (as in the NCM), but mainly by real-sector variables such as relative income and growth rates (see Section 3.3). Finally, the GPM does not impose an assumption of perfect foresight or "rational expectations", but instead accepts that the future is uncertain. As such, saving and investment patterns are not the result of optimal consumption smoothing based on prior knowledge of the future but of economic decision-making in an uncertain world:

> The key rationale for international macroeconomic policy coordination lies in its capacity to reduce "secondary uncertainty" and at the same time to build up confidence around a shared vision on the world's major policy challenges and options, or what Keynes has called "conventional expectations" of the uncertain future. (Storm, p. 28)

Storm illustrates how the predictions of the GPM differ from those of the NCM on the basis of recent GPM-generated scenarios exploring the potential effects of coordinated cross-border fiscal policy. Storm finds that the cross-border multipliers generated by the GPM from EDEs to developed countries are in line with those estimated by the IMF, while those running in the opposite direction are somewhat higher (and therefore possibly over-estimated). The positive results of cross-border coordination of exchange rates, fiscal policy, monetary policy and capital account management predicted by the GPM operate not only through direct fiscal multipliers but also though an investment response (an "accelerator" mechanism) and through Kaldorian processes of productivity growth and cumulative causation. Storm concludes that these results are more plausible than the zero-sum game implied by NCM models and that GPM

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[13] "[W]hen governments follow conservative fiscal policies and liberalize the financial system, the private sector becomes the arbiter of domestic credit creation and external financial balances, which in the context of a world with global capital and product markets generates sustained imbalances and presents ongoing risks of instability with alternating recessions and periods of recovery as fluctuations in asset valuations, increasingly synchronized, impact financial flows in each country." (Cripps et al., 2011)

[14] This was highlighted in direct exchanges with the UNCTAD staff currently managing the GPM.

scenarios thus provide a useful tool for “indicative planning” exercises. Landesman offers a similar view, concluding that the GPM “is well-designed to undertake ‘policy analysis’ exercises, particularly for medium-run analysis” and concurs with the other experts that an “important strength is the emphasis on exploring possibilities for the impact of global and regional policy coordination”.

4.2 Employment and income distribution

The GPM includes a detailed set of demographic and labour market data, many of which are derived from series produced by the International Labour Organisation. Population and employment data are disaggregated by age group and gender, as are data series for participation and unemployment rates. Onaran notes that the GPM “includes behavioural equations for labour force participation, unemployment, wage and price setting, and primary income distribution”. Given the inclusion of long-run demand effects and hysteresis, an important feature of the model is the possibility of persistent involuntary unemployment. Onaran argues that this distinguishes the GPM from neoclassical models which assume a long-run “natural rate” of unemployment determined by supply-side factors.

In model simulations, behavioural equations determine net migration and labour force participation (the latter is disaggregated by gender). Demographic projections are imported directly from the UN Population Division. Migration and demographics combine to determine population size and structure. Labour force participation is econometrically estimated as a function of GDP per capita, urbanisation and changing demographic structure due to ageing. The behavioural specification posits that demand-side factors are the key determinant of unemployment. Since growth and employment rates are not directly linked, recent labour market features such as jobless growth or stagnant productivity alongside strong employment performance are both compatible with the model structure.

A second important feature of the GPM highlighted by Onaran is the way in which the division of national income between wages and profits is determined. Unlike in models constructed on the basis of an aggregate production function in which the primary determinant of relative factor incomes is the technical specification of that production function (including more complex versions in which the specification varies through time due to technical advancement), bargaining power between workers and firms plays an important role in determining the distribution of income in the GPM. This is modelled as a price mark-up over labour costs imposed by firms. As a result, the functional income distribution is strongly path-dependent but is affected by “…factors including fluctuations in activity and the terms of trade, public policy and incentives and longer-run institutional changes” (Cripps & Izurieta, 2014).

There are a number of mechanisms by which shifts in income distribution feed through to aggregate demand. Investment responds positively to a higher profit share, however this effect is found to be moderate and relatively short-lived. Consumption demand reacts negatively to the reduction in labour income. A lower wage share will both reduce labour costs and depress consumption demand so the overall effect on imports and exports and therefore on the real exchange rate depends on the relative magnitude of these effects. Shifts in demand for exports and the real exchange rate then play a role in determining aggregate demand in each country. Since shifts in income distribution influence demand for traded goods, global aggregate demand is also affected by country-level shifts in income distribution.

Overall, it is found that the net effect of an increase in the profit share is to weaken aggregate demand. Onaran argues that this is consistent with a growing volume of empirical evidence (for example, Berg et al., 2012; Ostry et al., 2014; Foerster & Cingano, 2014). This has led to increasing recognition among policy-makers and international organisations that rising inequality may have negative implications for economic performance.

Onaran notes that the current literature largely overlooks the demand-side effects of inequality, focusing instead on the potential effects of inequality on "human capital" accumulation, political instability and weakened incentives for capital investment. In contrast, literature in the structuralist Keynesian tradition emphasises the effect of inequality in weakening aggregate demand and therefore reducing rates of capital accumulation and productivity growth (Rowthorn, 1981; Dutt, 1984; Bhaduri & Marglin, 1990). The GPM follows this tradition which regards labour income as both a cost and a source of demand, so that a range of possible outcomes and regimes are possible as shifts in distribution occur.

Onaran and others (e.g. Stockhammer, 2013) argue there are links between rising income inequality, global current account imbalances and the accumulation of private debt. Faced with stagnant wages, households in Anglo-Saxon countries resorted to private debt in order to maintain consumption. In this way, aggregate demand was prevented from falling in these countries. In contrast, the result of wage compression in Northern European nations was an increase in national saving as exports compensated for weak domestic demand. The combination of these two outcomes led to the emergence of today's persistent current account surplus and deficit positions. [15]

[15] Essentially same point was made after the crisis by Fitoussi & Stiglitz: "…aggregate demand deficiency preceded the financial crisis and was due to structural changes in income distribution. As the propensity to consume out of low incomes is generally larger, this long-term

In the GPM global structure, the negative effect of higher profit shares on demand is amplified when shifts in income distribution occur in several countries simultaneously. This could occur, for example, as a result of synchronised reforms aimed at labour market flexibility with the intention of achieving greater export competitiveness (for an analytical treatment, see Capaldo & Izurieta, 2013). Onaran examines the GPM projections of this kind of "race to the bottom", comparing them to her own research on the interaction between shifts in income distribution and aggregate demand in a global system (Onaran & Galanis 2012, 2014).[16] She finds that the "the results are consistent with our recent estimations … and the magnitudes of the multiplier effects are very similar". The presence of cross-border spillovers from shifts in income distribution are found to be significant, providing strong justification for coordinated cross-border demand management.

5 Conclusion

It is clear from the expert reports that the GPM is an important and distinctive policy modelling tool. It differs significantly in its methodology and assumptions from the neoclassical DSGE models which dominate academia and have increasingly replaced structural econometric models for the purposes of policy-making in international organisations and governments. Yet the aftermath of the global financial crisis has demonstrated the serious deficiencies of these supply-side models which assert that the world economy will always return to long-run trend growth, deny any role for international policy coordination and assume away the significance of international and domestic debtor and creditor positions.

In contrast, the GPM draws on a long tradition of empirically-informed macroeconomic modelling. The modelling methodology and key assumptions are highlighted in the expert reports: economic systems are demand-driven, with multipliers in line with

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trend in income redistribution by itself would have had the macroeconomic effect of depressing aggregate demand. In the US the compression of low incomes was compensated by the reduction of household savings and by mounting indebtedness that allowed spending patterns to be kept virtually unchanged. …Most European countries tread a different path. The redistribution to higher incomes resulted in an increase in national savings and depressed growth. … These two paths were mutually reinforcing because the savings from the EU zone contributed to the financing of US borrowing, along with surpluses of other regions. … Thus, the combination of structural disequilibria that goes by the name of global imbalances resulted in a fragile equilibrium that temporarily solved the aggregate demand problem on a global scale at the expense of future growth." (Fitoussi & Stiglitz, 2009); See also Cripps et al. (2011).

[16] See also Naastepad & Storm (2007); Stockhammer et al. (2009); Hein & Vogel (2008)

several recent empirical estimates; productivity growth is endogenously determined; the distribution of income is modelled explicitly and has feedback effects on demand; international trade is modelled in detail; and the financial and monetary system is modelled using stock-flow consistent accounting techniques. This empirically grounded modelling approach has clear advantages for policy analysis. Storm takes that view that the GPM is "the only official model which is capable of exploring policy and policy cooperation in ways that support the development aspirations of the EDEs".

The GPM is evidently a unique and vital tool. Construction of the databank alone is a remarkable achievement – Onaran describes it as an "invaluable" resource for researchers. Despite strong support for the ongoing use and development of the GPM, two significant threats are highlighted in the expert reports. The first is lack of funding, staffing and support from official institutions. The second is the continuing ideological opposition to non-neoclassical econometric models. As Storm puts it, models such as the GPM are under threat as result of "the attempt by IMF economists to appropriate a central coordinating role in macro policy making for the Fund itself". Lavoie concludes that it is an "absolute necessity" that realistic macroeconomic models such as the GPM, are "supported by international organisations, who must not succumb to the fluctuating fads of academia in economics."

It is clear that the pendulum of academic fashion is now swinging back in the other direction: neoclassical models are increasingly under attack for their lack of realism and unsuitability for real-world policy-making applications. The need to abandon unilateral reliance on monetary policy and to begin working towards international policy coordination is clear. The importance of cross-border capital flows and balance sheet positions is increasingly recognised. Income inequality is rising up the list of issues faced by policy-makers. The dynamics of development, catching up and falling behind are no longer seen as simple trajectories of 'convergence' but as complex heterogeneous processes. Policy-makers need tools to enable them to explore these complex issues. The GPM is well-suited for such a task.

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